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AEROSPATIALE AS 355F TWINSTA..(U) FEDERAL AVIATION
ADMINISTRATION WASHINGTON DC OFFICE OF ENVIR..
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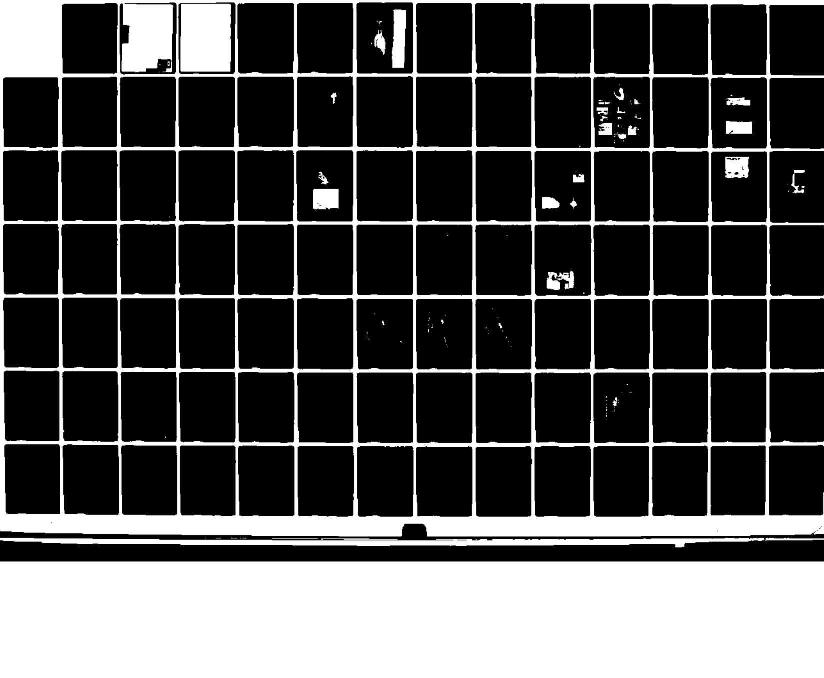

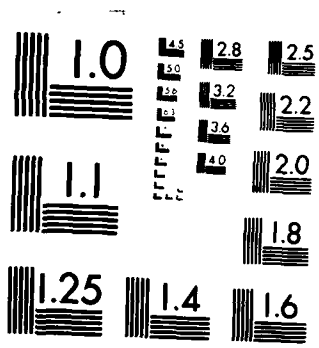

MICROCOPY RESOLUTION TEST CHART
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16. Abstract
This report documents the results of a Federal Aviation Administration (FAA) noise measurement flight test program with the TwinStar twin-jet helicopter. The report contains documentary sections describing the acoustical characteristics of the subject helicopter and provides analyses and discussions addressing topics ranging from acoustical propagation to environmental impact of helicopter noise.

This report is the fourth in a series of seven documenting the FAA helicopter noise measurement program conducted at Dulles International Airport during the summer of 1983. The TwinStar test program involved the acquisition of detailed acoustical, position and meteorological data.

This test program was designed to address a series of objectives including: 1) acquisition of acoustical data for use in assessing heliport environmental impact, 2) documentation of directivity characteristics for static operation of helicopters, 3) establishment of ground-to-ground and air-to-ground acoustical propagation relationships for helicopters, 4) determination of noise event duration influences on energy dose acoustical metrics, 5) examination of the differences between noise measured by a surface mounted microphone and a microphone mounted at a height of four feet (1.2 meters), and 6) documentation of noise levels acquired using international helicopter noise certification test procedures.

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AEROSPATIALE AS 355F TWINSTAR

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GLOSSARY

AGL	-	Above ground level
AIR	-	Aerospace Information Report
AL	-	A-Weighted sound level, expressed in decibels (See L_A)
AL_M	-	Maximum A-weighted sound level, expressed in decibels (see L_{AM})
AL_{AM}	-	As measured maximum A-weighted Sound Level
ALT	-	Aircraft altitude above the microphone location
APP	-	Approach operational mode
CLC	-	Centerline Center
CPA	-	Closest point of approach
d	-	Distance
dB	-	Decibel
dBA	-	A-Weighted sound level expressed in units of decibels (see A_L)
df	-	Degree of freedom
Δ	-	Delta, or change in value
$\Delta 1$	-	Correction term obtained by correcting SPL values for atmospheric absorption and flight track deviations per FAR 36, Amendment 9, Appendix A, Section A36.11, Paragraph d
$\Delta 2$	-	Correction term accounting for changes in event duration with deviations from the reference flight path
DUR(A)	-	"10 dB-Down" duration of L_A time history
EPNL	-	Effective perceived noise level (symbol is LEPN)

EV	-	Event, test run number
FAA	-	Federal Aviation Administration
FAR	-	Federal Aviation Regulation
FAR-36	-	Federal Aviation Regulation, Part 36
GLR	-	Graphic level recorder
HIGE	-	Hover-in-ground effect
HOGE	-	Hover-out-of-ground effect
IAS	-	Indicated airspeed
ICAO	-	International Civil Aviation Organization
IRIG-B	-	Inter-Range Instrumentation Group B (established technical time code standard)
K(DUR)	-	The constant used to correct SEL for distance and velocity duration effects in $\Delta 2$
KIAS	-	Knots Indicated Air Speed
K(P)	-	Propagation constant describing the change in noise level with distance
K(S)	-	Propagation constant describing the change in SEL with distance
Kts	-	Knots
L_A	-	A-Weighted sound level, expressed in decibels
Leq	-	Equivalent sound level
LFO	-	Level Flyover operational mode
M_A	-	Advancing blade tip Mach number
M_R	-	Rotational Mach number
M_T	-	Translational Mach number
N	-	Sample Size
NWS	-	National Weather Service

$OASPL_M$	-	Maximum overall sound pressure level in decibels
PISLM	-	Precision integrating sound level meter
PNL_M	-	Maximum perceived noise level
$PNLT_M$	-	Maximum tone corrected perceived noise level
POP	-	Photo overhead positioning system
Q	-	Time history "shape factor"
RH	-	Relative Humidity in percent
RPM	-	Revolutions per minute
SAE	-	Society of Automotive Engineers
SEL	-	Sound exposure level expressed in decibels. The integration of the AL time history, normalized to one second (symbol is L_{AE})
SEL_{AM}	-	As measured sound exposure level
$SEL-AL_M$	-	Duration correction factor
SHP	-	Shaft horse power
SLR	-	Single lens reflex (35 mm camera)
SPL	-	Sound pressure level
T	-	Ten dB down duration time
TC	-	Tone correction calcualted at $PNLT_M$
T/O	-	Takeoff
TSC	-	Department of Transportation, Transportation Systems Center
V	-	Velocity
VASI	-	Visual Approach Slope Indicator
V_H	-	Maximum speed in level flight with maximum continuous power
V_{NE}	-	Never-exceed speed
Vy	-	Velocity for best rate of climb

1.0 Introduction - This report documents the results of a Federal Aviation Administration (FAA) noise measurement/flight test program involving the Aerospatiale Twinstar helicopter. The report contains documentary sections describing the acoustical characteristics of the subject helicopter and provides analyses and discussions addressing topics ranging from acoustical propagation to environmental impact of helicopter noise.

This report is the fourth in a series of seven documenting the FAA helicopter noise measurement program conducted at Dulles International Airport during the summer of 1983.

The Twinstar test program was conducted by the FAA in cooperation with Aerospatiale Helicopter Corporation and a number of supporting Federal agencies. The rigorously controlled tests involved the acquisition of detailed acoustical, position and meteorological data.

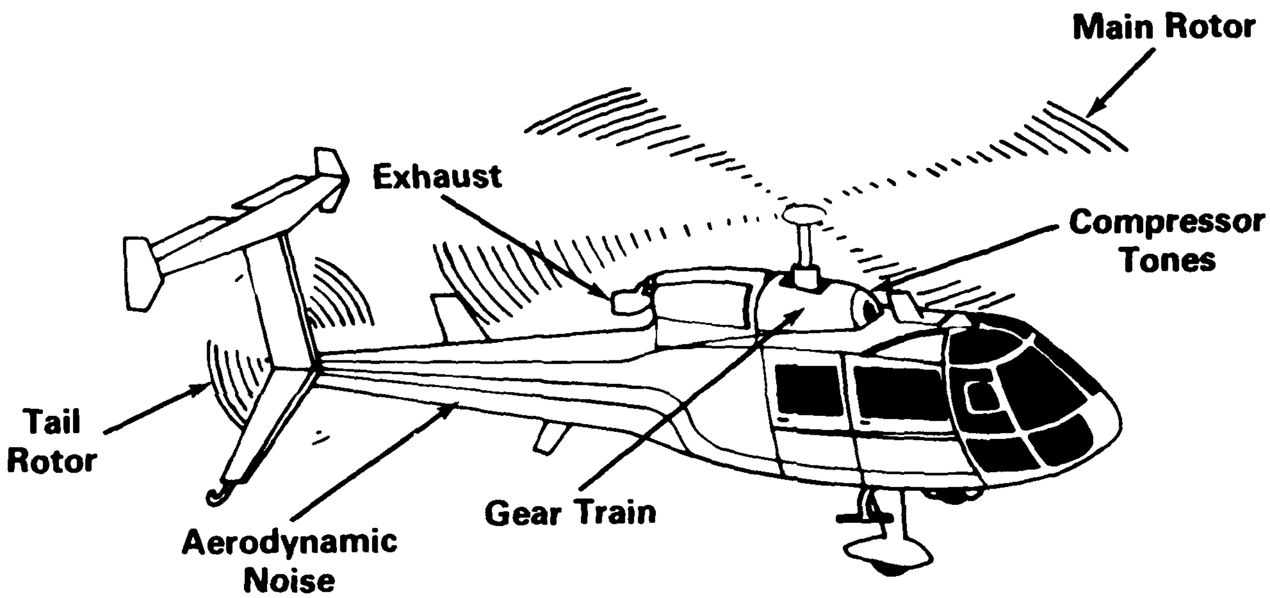
This test program was designed to address a series of objectives including: 1) acquisition of acoustical data for use in heliport environmental impact analyses, 2) documentation of directivity characteristics for static operation of helicopters, (3) establishment of ground-to-ground and air-to-ground acoustical propagation relationships for helicopters, 4) determination of noise event duration influences on energy dose acoustical metrics, 5) examination of the differences between noise measured by a surface mounted microphone and a microphone mounted at a height of four feet (1.2 meters), and 6) documentation of noise levels acquired using international helicopter noise certification test procedures.

The helicopter is a complex acoustical source generating noise from many different origins. Figure 1.1 provides a diagram identifying some of these sources. Two other noise generating mechanisms associated with forward flight effects (both associated with flight effects and both producing impulsive noise) are blade vortex interaction (see Figure 9.14) and high advancing tip Mach Numbers. These figures are provided for the reader's reference.

The appendices to this document provide a reference set of acoustical data for the TwinStar helicopter operating in a variety of typical flight regimes. The first seven chapters contain the introduction and description of the helicopter, test procedures and test equipment. Chapter 8 describes analyses of flight trajectories and meteorological data and is documentary in nature. Chapter 9 delves into the areas of acoustical propagation, helicopter directivity for static operations, and variability in measured acoustical data over various propagation surfaces. The analyses of Chapter 9 in some cases succeed in establishing relationships characterizing the acoustic nature of the subject helicopter, while in other instances the results are too variant and anomalous to draw any firm conclusions. In any event, all of the analyses provide useful insight to people working in the field of helicopter environmental acoustics, either in providing a tool or by identifying areas which need the illumination of further research efforts.

FIGURE 1.1

Helicopter Noise Sources



TEST HELICOPTER DESCRIPTION

2.0 Test Helicopter Description - The AS 355F TwinStar is a twin-engined, light, general purpose helicopter. The aircraft is marketed and supported by Aerospatiale Helicopter Corporation of Grand Prairie, Texas and was certificated by the FAA in November of 1981. Intended primarily for commercial companies working in the oil industry, the AS 355F provides cabin outfitting for a pilot, co-pilot and four passengers. There are also three baggage holds with external doors.

Selected operational characteristics, obtained from the helicopter manufacturer, are presented in Table 2.1.

Table 2.2 presents a summary of the flight operational reference parameters determined using the procedures specified in the International Civil Aviation Organization (ICAO) noise certification testing requirements. Presented along with the operational parameters are the altitudes that one would expect the helicopter to attain (referred to the ICAO reference test sites). This information is provided so that the reader may implement an ICAO type data correction using the "As Measured" data contained in this report. This report does not undertake such a correction, leaving it as the topic of a subsequent report.

TABLE 2.1

HELICOPTER CHARACTERISTICS

HELICOPTER MANUFACTURER	: Aerospatiale
HELICOPTER MODEL	: AS 355F Twinstar
HELICOPTER TYPE	: Single Rotor
TEST HELICOPTER N-NUMBER	: 5780 D
MAXIMUM GROSS TAKEOFF WEIGHT	: 5070 lbs
NUMBER AND TYPE OF ENGINE(S)	: 2 Allison 250C20f
SHAFT HORSE POWER (PER ENGINE)	: 420 HP
MAXIMUM CONTINUOUS POWER	: 321 HP
SPECIFIC FUEL CONSUMPTION AT MAXIMUM POWER (LB/HR/HP)	: .701 lb/hr/hp
NEVER EXCEED SPEED (V_{NE})	: 173 mph (150 kts)
MAX SPEED IN LEVEL FLIGHT WITH MAX CONTINUOUS POWER (V_H)	: 145 mph (126 kts)
SPEED FOR BEST RATE OF CLIMB (Vy)	: 63 mph (55 kts)
BEST RATE OF CLIMB	: 1870 fpm

MAIN AND TAIL ROTOR SPECIFICATIONS

	MAIN	TAIL
ROTOR SPEED (100%)	: 394RPM	2088 RPM
DIAMETER	: 420.8"	73.2"
CHORD	: 13.8"	7.28"
NUMBER OF BLADES	: 3	2
PERIPHERAL VELOCITY	: 723.5 fps	667 fps
DISK LOADING	: 5.25 lb/ft^2	---
FUNDAMENTAL BLADE PASSAGE FREQUENCY	: 20 Hz	70 Hz
ROTATIONAL TIP MACH NUMBER (77°F)	: .6371	.5874

TABLE 2.2

ICAO REFERENCE PARAMETERS

	TAKEOFF	APPROACH	LEVEL FLYOVER
AIRSPEED (KTS)	: 55	55	113.4
RATE OF CLIMB/DESCENT (fpm)	: 1870	583	NA
CLIMB/DESCENT ANGLE (DEGREES)	: 19.6	6.0	NA
ALTITUDE/CPA (FEET)			
SITE 5	: 475/447	342/340	492
SITE 1	: 650/612	394/392	492
SITE 4	: 825/778	446/443	492
SLANT RANGE (FEET) TO			
SITE 2	: 815	630	696
SITE 3	: 815	630	696

NOTE

A preliminary comparison of noise levels (for the ICAO noise certification flight regimes) has been made by engineers from Aerospatiale Helicopters using results from previous tests in France and data presented in this report. The Aerospatiale engineers cite generally good agreement, showing the uncorrected data in this report as 1.2 EPNdB higher than French results for level flyover, 1.1 EPNdB l ower for approach, and 0.3 EPNdB l ower for takeoff operations. In the process of imlementing the full ICAO correction procedure, (in a subsequent report) a more thorough comparison will be made.

At the present time, a Helicopter Noise Measurement Repeatability Program is being cnducted by The International Civil Aviation Organization (ICAO). This program involves eight to ten different national measurement teams conducting noise tests on the same helicopter model, a Bell 206-L3. In the process of analyzing results of that program, a compendium of other comparative helicopter noise measurements will also be developed. In that context, the results reported in this document wil be compared in detail with other detailed results.

TEST SYNOPSIS

3.0 Test Synopsis - Below is a listing of pertinent details pertaining to the execution of the helicopter tests.

1. Test Sponsor, Program Management, and Data Analysis: Federal Aviation Administration, Office of Environment and Energy, Noise Abatement Division, Noise Technology Branch (AEE-120).

2. Test Helicopter: AS 355F TwinStar, provided by Aerospatiale Helicopter Corporation

3. Test Date: Tuesday, June 7, 1983

4. Test Location: Dulles International Airport, Runway 30 over-run area.

5. Noise Data Measurement (recording), processing and analysis: Department of Transportation (DOT), Transportation Systems Center (TSC), Noise Measurement and Assessment Facility.

6. Noise Data Measurement (direct-read), processing and analysis: FAA, Noise Technology Branch (AEE-120).

7. Cockpit instrument photo documentation; photo-altitude determination system; documentary photographs: Department of Transportation, Photographic Services Laboratory.

8. Meteorological Data (fifteen minute observations): National Weather Service Office, Dulles International Airport.

9. Meteorological Data (radiosonde/rawinsonde weather balloon launches): National Weather Service Upper Air Station, Sterling Park, Virginia.

FIGURE 3.1

Flight Test and Noise Measurement Personnel In Action

10. Meteorological Data (on site observations): DOT-TSC.

11. Flight Path Guidance (portable visual approach slope indicator (VASI) and theodolite/verbal course corrections): FAA Technical Center, ACT-310.

12. Air Traffic Control: Dulles International Airport Air Traffic Control Tower.

13. Test site preparation; surveying, clearing underbrush, connecting electrical power, providing markers, painting signs, and other physical arrangements: Dulles International Airport Grounds and Maintenance, and Airways Facilities personnel.

Figure 3.1 is a photo collage of flight test and measurement personnel performing their tasks.

3.1 Measurement Facility - The noise measurement testing area was located adjacent to the approach end of Runway 12 at Dulles International Airport. (The approach end of Runway 12 is synonymous with Runway 30 over-run area.) The low ambient noise level, the availability of emergency equipment, and the security of the area all made this location desirable. Figure 3.2 provides a photograph of the Dulles terminal and of the test area.

The test area adjacent to the runway was nominally flat with a ground cover of short, clipped grass, approximately 1800 feet by 2200 feet, and bordered on north, south, and west by woods. There was minimum interference from the commercial and general aviation activity at the airport since Runway 12/30 was closed to normal traffic during the tests. The runways used for normal traffic, 1L and 1R, were approximately 2 and 3 miles east, respectively, of the test site.

Figure 3.2

The Terminal and Air Traffic Control Tower
at Dulles International Airport

Approach to Runway 12 at Dulles Noise
Measurement Site for 1983 Helicopter Tests

The flight track centerline was located parallel to Runway 12/30 centered between the runway and the taxiway. The helicopter hover point for the static operations was located on the southwest corner of the approach end of Runway 12. Eight noise measurement sites were established in the grassy area adjacent to the Runway 12 approach ground track.

3.2 Microphone Locations - There were eight separate microphone sites located within the testing area, making up two measurement arrays. One array was used for the flight operations, the other for the static operations. A schematic of the test area is shown in Figure 3.3.

A. Flight Operations - The microphone array for flight operations consisted of two sideline sites, numbered 2 and 3 in Figure 3.3, and three centerline sites, numbered 5, 1, and 4, located directly below the flight path of the helicopter. Since site number 3, the north sideline site, was located in a lightly wooded area, it was offset 46 feet to the west to provide sufficient clearance from surrounding trees and bushes.

B. Static Operations - The microphone array for static operations consisted of sites 7H, 5H, 1H, 2, and 4H. These sites were situated around the helicopter hover point which was located on the southwest corner of the approach end of Runway 12. These site locations allowed for both hard and soft ground-to-ground propagation paths.

3.3 Flight Path Markers and Guidance System Locations - Visual cues in the form of squares of plywood painted bright yellow with a black "X" in the center were provided to define the takeoff rotation point. This point was located 1640 feet (500 m) from centerline center (CLC) microphone

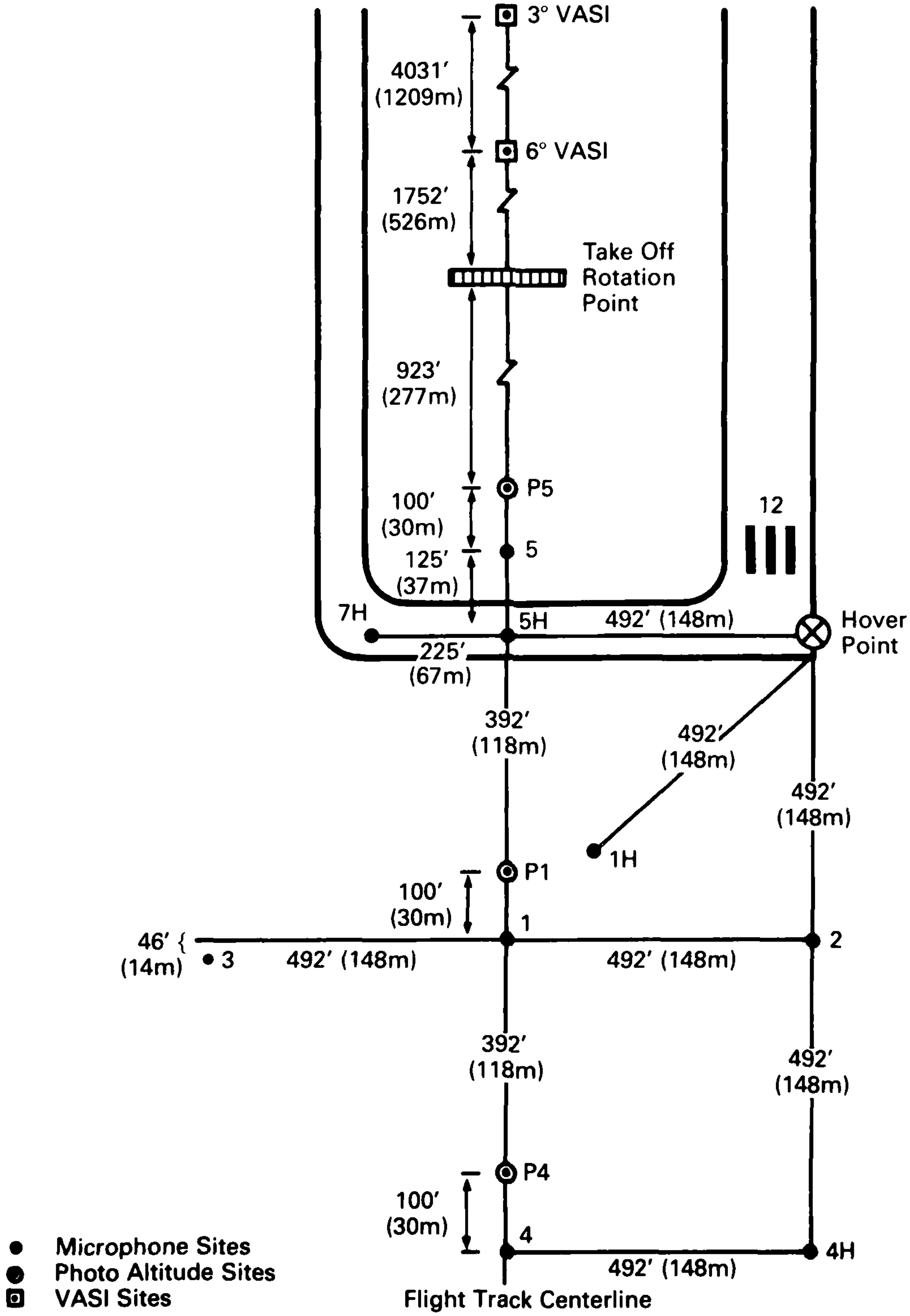
location. Four portable, battery-powered spotlights were deployed at various locations to assist pilots in maintaining the array centerline. To provide visual guidance during the approach portion of the test, a standard visual approach slope indicator (VASI) system was used. In addition to the visual guidance, the VASI crew also provided verbal guidance with the aid of a theodolite. Both methods assisted the helicopter pilot in adhering to the microphone array centerline and in maintaining the proper approach path. The locations of the VASI from CLC are shown in the following table.

Approach Angle (degrees)	Distance from CLC (feet)
12	1830
9	2456
6	3701
3	7423

Each of these locations provided a glidepath which crossed over the centerline center microphone location at an altitude of 394 feet. This test program included approach operations utilizing 6 and 9 degree glide slopes.

FIGURE 3.3

Noise Measurement and Photo Site Schematic



NOTES: Broken Line Indicates not to Scale.
Metric Measurements to
Nearest Meter.

TEST PLANNING AND BACKGROUND

4.0 Test Planning/Background Activities - This section provides a brief discussion of important administrative and test planning activities.

4.1 Test Program Advance Briefings and Coordination - A pre-test briefing was conducted approximately one month prior to the test. The meeting was attended by all pilots participating in the test, along with FAA program managers, manufacturer test coordinators, and other key test participants from the Dulles Airport community. During this meeting, the airspace safety and communications protocol were rigorously defined and at the same time test participants were able to iron out logistical and procedural details. On the morning of the test, a final brief meeting was convened on the flight line to review safety rules and coordinate last-minute changes in the test schedule.

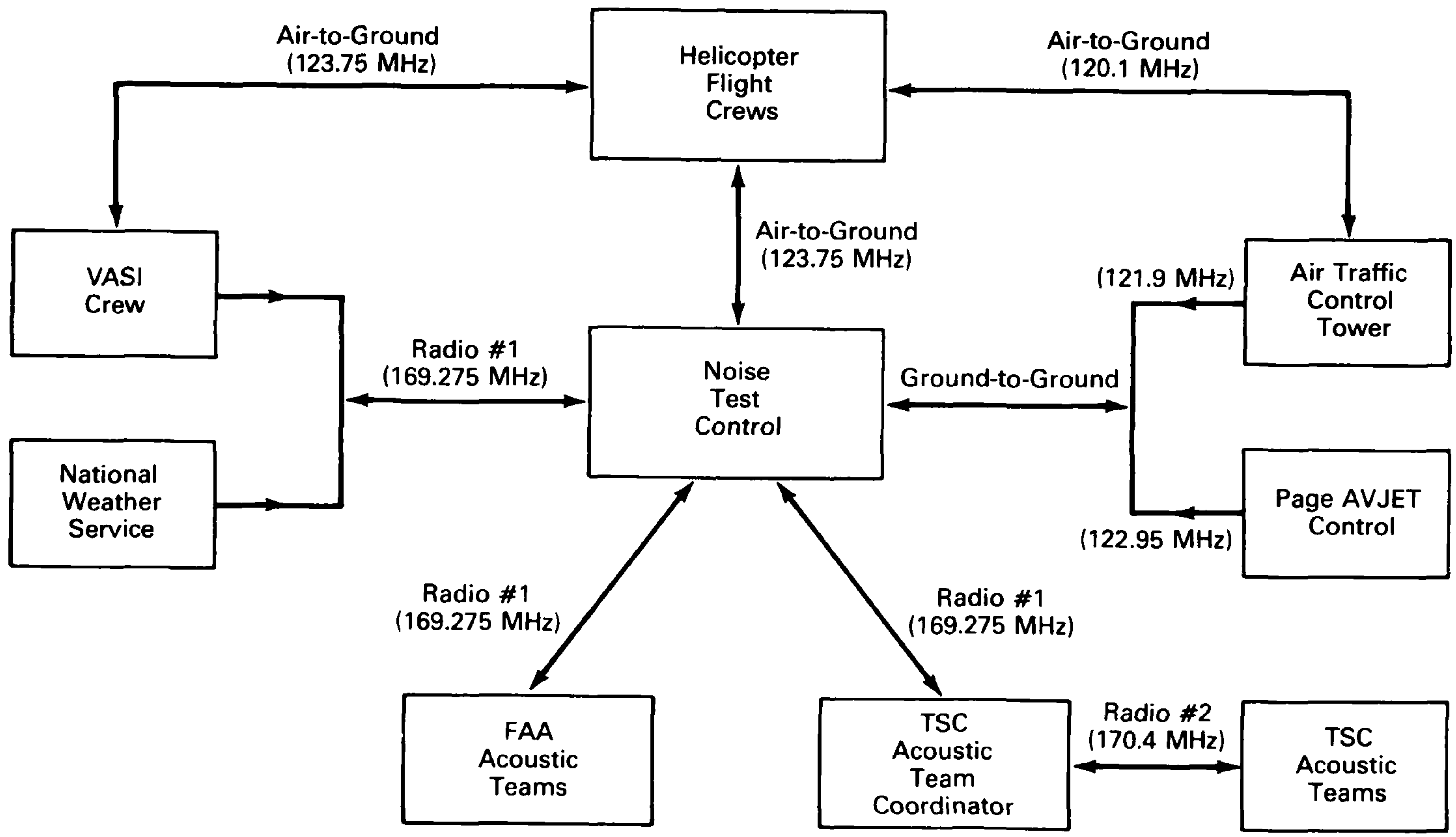
4.2 Communications Network - During the helicopter noise measurement test, an elaborate communications network was utilized to manage the various systems and crews. This network was headed by a central group which coordinated the testing using three two-way radio systems, designated as Radios 1-3.

Radio 1 was a walkie talkie system operating on 169.275 MHz, providing communications between the VASI, National Weather Service, FAA Acoustic Measurement crew, the TSC acoustic team coordinator, and the noise test coordinating team.

Radio 2 was a second walkie talkie system operating on 170.40 MHz, providing communications between the TSC acoustic team coordinator and the TSC acoustic measurement teams.

FIGURE 4.1

Helicopter Noise Test Communication Network Schematic



Radio 3, a multi-channel transceiver, was used as both an air-to-ground and ground-to-ground communications system. In air-to-ground mode it provided communications between VASI, helicopter flight crews, and noise test control on 123.175 MHz. In ground-to-ground mode it provided communications between the air traffic control tower (121.9 MHz), Page Avjet (the fuel source; 122.95 MHz), and noise test control.

A schematic of this network is shown in Figure 4.1.

4.3 Local Media Notification - Noise test program managers working through the FAA Office of Public Affairs released an article to the local media explaining that helicopter noise tests were to be conducted at Dulles Airport on June 7, the test day commencing around dawn and extending through midday. The article described general test objectives, flight paths, and rationale behind the very early morning start time (low wind requirements). In the case of a farm located very close to the airport, a member of the program management team personally visited the residents and explained what was going to be involved in the test. As a consequence of these efforts (it is assumed), there were very few complaints about the test program.

4.4 Ambient Noise - One of the reasons that the Dulles Runway 30 over-run area was selected as the test site was the low ambient noise level in the area. Typically one observed an A-Weighted LEQ on the order of 45 dB, with dominant transient noise sources primarily from the avian and insect families. The primary offender was the Collinus Virginianus, commonly known as the bobwhite, quail, or partridge. The infrequent intrusive

sound pressure levels were on the order of 55 dB centered in the 2000 Hz one-third octave band. A drawing of the noisy offender and a narrow band analysis of the song may be found in Figure 4.2.

As an additional measure for safety and for lessening ambient noise, a Notice to Airmen or NOTAM was issued advising aircraft of the noise test, and indicating that Runway 12/30 was closed for the duration of the test.

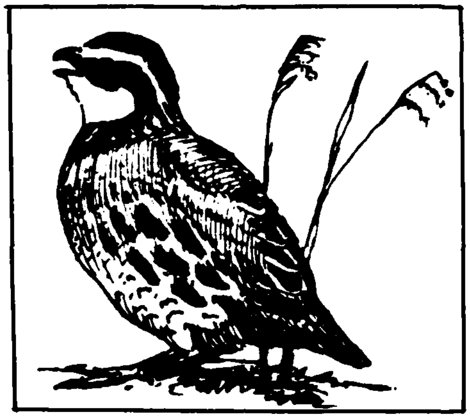
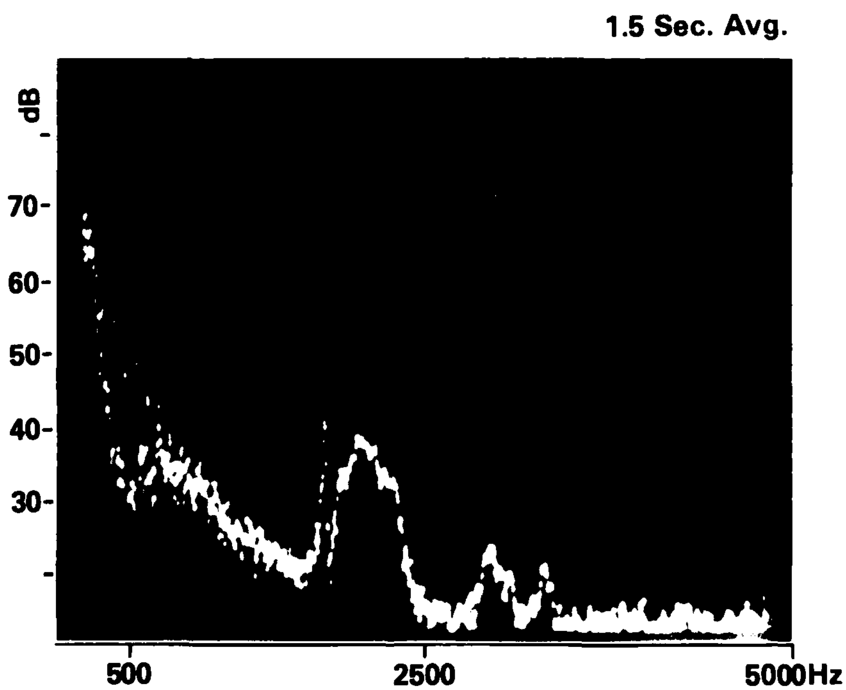


FIGURE 4.2



DATA ACQUISITION AND GUIDANCE SYSTEMS

5.0 Data Acquisition and Guidance Systems - This section provides a detailed description of the test program data acquisition systems, with special attention given to documenting the operational accuracy of each system. In addition, discussion is provided (as needed) of field experiences which might be of help to others engaged in controlled helicopter noise measurements. In each case, the location of a given measurement system is described relative to the helicopter flight path.

5.1 Approach Guidance System - Approach guidance was provided to the pilot by means of a visual approach slope indicator (VASI) and through verbal commands from an observer using a ballon-tracking theodolite. (A picture of the theodolite is included in Figure 3.1, in Section 3.0.) The VASI and theodolite were positioned at the point where the approach path intercepted the ground.

The VASI system used in the test was a 3-light arrangement giving vertical displacement information within ± 0.5 degrees of the reference approach slope. The pilot observed a green light if the helicopter was within 0.5 degrees of the approach slope, red if below the approach slope, white if above. The VASI was adjusted and repositioned to provide a variety of approach angles. A picture of the VASI is included in Figure 3.1.

The theodolite system, used in conjunction with the VASI, also provided accurate approach guidance to the pilot. A brief time lag existed between the instant the theodolite observor perceived deviation, transmitted a command, and the pilot made the correction; however, the theodolite crew was generally able to alert the pilot of approach path deviations (slope and lateral displacement) before the helicopter exceeded the limits of the one degree green light of the VASI. Thus, the helicopter only

occasionally and temporarily deviated more than 0.5 degrees from the reference approach path.

Approach paths of 6 and 9 degrees were used during the test program. Table 5.1 summarizes the VASI beam width at each measurement location for a variety of the approach angles used in this test.

TABLE 5.1

REFERENCE HELICOPTER ALTITUDES FOR APPROACH TESTS
(all distances expressed in feet)

	MICROPHONE NO. 4	MICROPHONE NO. 1	MICROPHONE NO. 5
APPROACH ANGLE = 3°	A = 8010 B = 420 C = ±70	A = 7518 B = 394 C = ±66	A = 7026 B = 368 C = ±62
6°	A = 4241 B = 446 C = ±37	A = 3749 B = 394 C = ±33	A = 3257 B = 342 C = ±29
9°	A = 2980 B = 472 C = ±27	A = 2488 B = 394 C = ±22	A = 1362 B = 316 C = ±18

A = distance from VASI to microphone location

B = reference helicopter altitude

C = boundary of the 1 degree VASI glide slope "beam width".

5.2 Photo Altitude Determination Systems - The helicopter altitude over a given microphone was determined by the photographic technique described in the Society of Automotive Engineers report AIR-902 (ref. 1). This technique involves photographing an aircraft during a flyover event and

proportionally scaling the resulting image with the known dimensions of the aircraft. The camera is initially calibrated by photographing a test object of known size and distance. Measuring the resulting image enables calculation of the effective focal length from the proportional relationship:

(image length)/(object length) = (effective focal length)/(object distance)

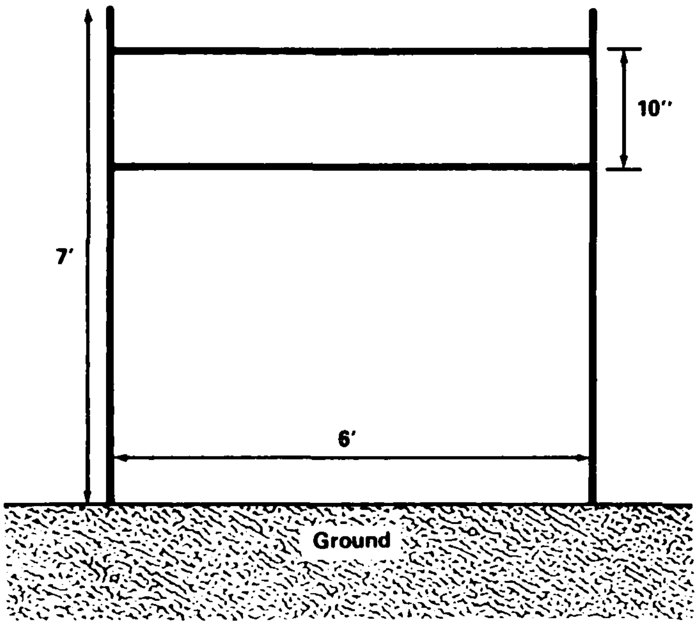
This relationship is used to calculate the slant distance from microphone to aircraft. Effective focal length is determined during camera calibration, object length is determined from the physical dimensions of the aircraft (typically the rotor diameter or fuselage) and the image size is measured on the photograph. These measurements lead to the calculation of object distance, or the slant distance from camera or microphone to aircraft. The concept applies similarly to measuring an image on a print, or measuring a projected image from a slide.

The SAE AIR-902 technique was implemented during the 1983 helicopter tests with three 35mm single lens reflex (SLR) cameras using slide film. A camera was positioned 100 feet from each of the centerline microphone locations. Lenses with different focal lengths, each individually calibrated, were used in photographing helicopters at differing altitudes in order to more fully "fill the frame" and reduce image measurement error.

The photoscaling technique assumes the aircraft is photographed directly overhead. Although SAE AIR-902 does present equations to account for deviations caused by photographing too soon or late, or by the aircraft deviating from the centerline, these corrections are not required when

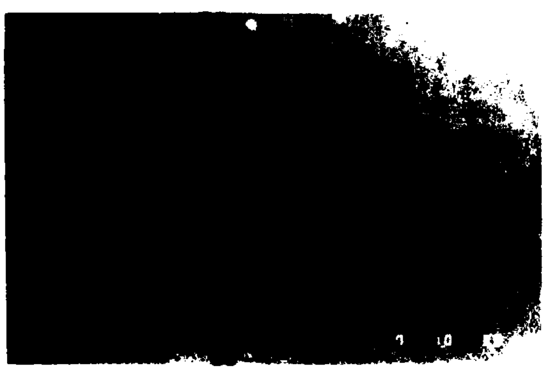
Figure 5.1

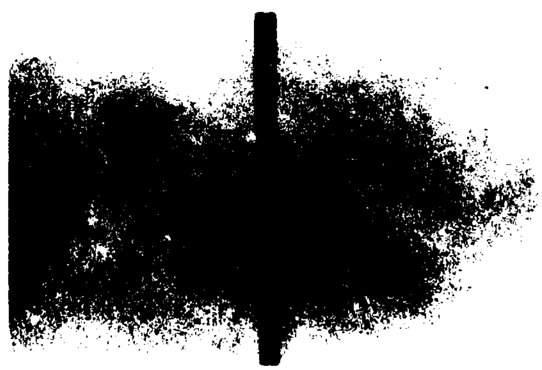
Photo Overhead Positioning System (Pop System)



Artist's Drawing of the Photo Overhead Positioning System (Figure is not to scale.)

Photographer using the POP system to photograph the helicopter.





Photographs of the AS 355F TwinStar, as taken by the photographer using the POP system.

deviations are small. Typically, most of the deviations were acoustically insignificant. Consequently, corrections were not required for any of the 1983 test photos.

The photographer was aided in estimating when the helicopter was directly overhead by means of a photo-overhead positioning system (POPS) as illustrated in the figure and pictures in Figure 5.1 The POP system consisted of two parallel (to the ground) wires in a vertical plane orthogonal to the flight path. The photographer, lying beneath the POP system, initially positioned the camera to coincide with the vertical plane of the two guide wires. The photographer tracked the approaching helicopter in the viewfinder and tripped the shutter when the helicopter crossed the superimposed wires. This process of tracking the helicopter also minimized image blurring and the consequent elongation of the image of the fuselage.

A scale graduated in 1/32-inch increments was used to measure the projected image. This scaling resolution translated to an error in altitude of less than one percent. A potential error lies in the scaler's interpretation of the edge of the image. In an effort to quantify this error, a test group of ten individuals measured a selection of the fuzziest photographs from the helciopter tests. The resulting statistics revealed that 2/3 of the participants were within two percent of the mean altitude. SAE AIR-902 indicates that the overall photoscaling technique, under even the most extreme conditions, rarely produces error exceeding 12 percent, which is equivalent to a maximum of 1 dB error in corrected sound level data. Actual accuracy varies from photo to photo; however, by using skilled photographers and exercising reasonable care in the measurements, the accuracy is good enough to ignore the resulting small error in altitude.

Tests were recently conducted in West Germany which compared this camera method with the more elaborate Kinotheodolite tracking method to discover which was best for determining overflight height and overground speed. Both methods were found to be reasonably accurate; thus, the simpler camera method remains appropriate for most test purposes (ref. 2).

5.3 Cockpit Photo Data - During each flight operation of the test program, cockpit instrument panel photographs were taken with a 35mm SLR camera, with an 85mm lens, and high speed slide film. These pictures served as verification of the helicopter's speed, altitude, and torque at a particular point during a test event. The photos were intended to be taken when the aircraft was directly over the centerline-center microphone site #1 (see Figure 3.3). Although the photos were not always taken at precisely that point, the pictures do represent a typical moment during the test event. When slides were projected onto a screen, it was possible to read and record the instrument readings with reasonable accuracy.The word typical is important because the snapshot freezes instrument readings at one moment in time, while actually the readings are constantly changing by a small amount because of instrument fluctuation and pilot input. Thus, fluctuations above or below reference conditions are to be anticipated. A reproduction of a typical cockpit photo is shown in Figure 5.2. This data acquisition system was augmented by the presence of an experienced cockpit obersver who provided additional documentation of operational parameters.

For future tests, the use of a video tape system is being considered to acquire a continuous record of cockpit parameters during each data run. Preliminary FAA studies (April 1984) indicate that this technique can be successful using off the shelf equipment.

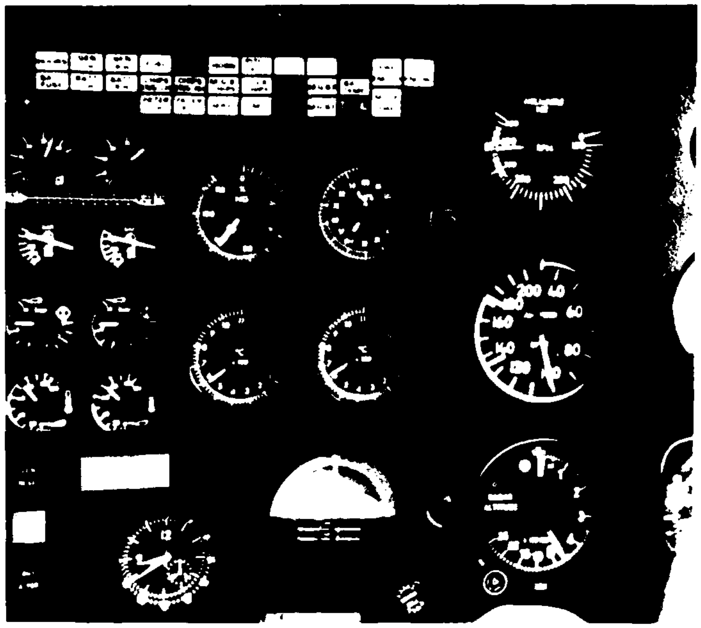


FIGURE 5.2

5.4 <u>Upper Air Meterorlogical Data Acquisition/NWS: Sterling, VA</u> - The National Weather Service (NWS) at Sterling, Virginia provided upper air meteorological data obtained from balloon-borne radiosondes. These data consisted of pressure, temperature, relative humidity, wind direction, and speed at 100' intervals from ground level through the highest test altitude. The balloons were launched approximately 2 miles north of the measurement array. To slow the ascent rate of the balloon, an inverted parachute was attached to the end of the flight train. The VIZ Accu-Lok (manufacturer) radiosonde employed in these tests consisted of sensors which sampled the ambient temperature, relative humidity, and pressure of the air. Each radiosonde was individually calibrated by the manufacturer. The sensors were coupled to a radio transmitter which emitted an RF signal of 1680 MHz sequentially pulse-modulated at rates corresponding to the values of sampled meteorological parameters. These signals were received

by the ground-based tracking system and converted into a continuous trace on a strip chart recorder. The levels were then extracted manually and entered into a minicomputer where calculations were performed. Wind speed and direction were determined from changes in position and direction of the "flight train" as detected by the radiosonde tracking system. Figure 5.3 shows technicians preparing to launch a radiosonde.

FIGURE 5.3

The manufacturer's specifications for accuracy are:

Pressure = ±4 mb up to 250 mb

Temperature = ±0.5°C, over a range of +30°C to -30°C

Humidity = ±5% over a range of ±25°C to 5°C

The National Weather Service has determined the "operational accuracy" of a radiosonde (as documented in an unpublished report entitled "Standard for Weather Bureau Field Programs", 1-1-67) to be as follows:

Pressure = ±2 mb, over a range of 1050 mb to 5 mb

Temperature = ±1°C, over a range of +50°C to -70°C

Humidity = ±5% over a range of +40°C to -40°C

The temperature and pressure data are considered accurate enough for general documentary purposes. The relative humidity data are the least reliable. The radiosonde reports lower than actual humidities when the air is near saturation. These inaccuracies are attributable to the slow response time of the humidity sensor to sudden changes. (Ref. 3).

For future research program testing, the use of a SODAR (acoustical sounding) system is being considered. The SODAR is a measurement system capable of defining the micro-wind structure, making the influences of wind speed, direction and gradient easier to identify and to assess in real time (Ref. 4).

5.5 <u>Surface Meteorological Data Acquisition/NWS: Dulles Airport</u> - The National Weather Service Station at Dulles provided temperature, windspeed, and wind direction on the test day. Readings were noted every 15 minutes. These data are presented in Appendix H. The temperature transducers were located approximately 2.5 miles east of the test site at a height of 6 feet (1.8 m) above the ground, the wind instruments were at a height of 30 feet (10 m) above ground level. The dry bulb thermometer and dew point transducer were contained in the Bristol (manufacturer) HO-61 system operating with $\pm$ one degree accuracy. The windspeed and direction were measured with the Electric Speed Indicator (manufacturer) F420C System, operating with an accuracy of 1 knot and $\pm 5°$.

On-site meterological data were also obtained by TSC personnel using a Climatronics (manufacturer) model EWS weather system. The anemometer and temperature sensor were located 10 feet above ground level at noise site 4. These data are presented in Appendix I. The following table

(Table 5.2) identifies the accuracy of the individual components of the EWS system.

TABLE 5.2

Sensor	Accuracy	Range	Time Constant
Windspeed	±.025 mph or 1.5%	0-100 mph	5 sec
Wind Direction	±1.5%	0-360° Mech 0-540° Elect	15 sec
Relative Humidity	±2% 0-100% RH	0-100% RH	10 sec
Temperature	±1.0°F	-40 to +120°F	10 sec

After "detection" (sensing), the meteorological data are recorded on a Rustrak (manufacturer) paperchart recorder. The following table (Table 5.3) identifies the range and resolutions associated with the recording of each parameter.

TABLE 5.3

Sensor	Range	Chart Resolution
Windspeed	0-25 TSC mod 0-50 mph	±0.5 mph
Wind Direction	0-540°	±5°
Relative Humidity	0-100% RH	±2% RH
Temperature	-40° to 120°F	±1°F

5.6.0 Noise Data Acquisition Sytems/System Deployment - This section provides a detailed description of the acoustical measurement systems employed in the test program along with the deployment plan utilized in each phase of testing.

5.6.1 Description of TSC Magnetic Recording Systems - TSC personnel deployed Nagra two-channel direct-mode tape recorders. Noise data were recorded with essentially flat frequency response on one channel. The same input data were weighted and amplified using a high frequency pre-emphasis filter and were recorded on the second channel. The pre-emphasis network rolled off those frequencies below 10,000 Hz at 20 dB per decade. The use of pre-emphasis was necessary in order to boost the high frequency portion of the acoustical signal (such as a helicopter spectrum) characterized by large level differences (30 to 60 dB) between the high and low frequencies. Recording gains were adjusted so that the best possible signal-to-noise ratio would be achieved while allowing enough "head room" to comply with applicable distortion avoidance requirements.

IRIG-B time code synchronized with the tracking time base was recorded on the cue channel of each system. The typical measurement system consisted of a General Radio 1/2 inch electret microphone oriented for grazing incidence driving a General Radio P-42 preamp and mounted at a height of four feet (1.2 meters). A 100-foot (30.5 meters) cable was used between the tripod and the instrumentation vehicle located at the perimeter of the test circle. A schematic of the acoustical instrumentation is shown in Figure 5.4.

Figure 5.4 also shows the cutaway windscreen mounting for the ground microphone. This configuration places the lower edge of the microphone diaphram approximately one-half inch from the plywood (4 ft by 4 ft) surface. The ground microphone was located off center in order to avoid natural mode resonant vibration of the plywood square.

5.6.2 FAA Direct Read Measurement Systems - In addition to the recording systems deployed by TSC, four direct read, Type-1 noise measurement systems were deployed at selected sites. Each noise measurement site consisted of an identical microphone-preamplifier system comprised of a General Radio 1/2-inch electret microphone (1962-9610) driving a General Radio P-42 preamplifier mounted 4 feet (1.2m) above the ground and oriented for grazing incidence. Each microphone was covered with a 3-inch windscreen.

Three of the direct read systems utilized a 100-foot cable connecting the microphone system with a General Radio 1988 Precision Integrating Sound Level Meter (PISLM). In each case, the slow response A-weighted sound level was output to a graphic level recorder (GLR). The GLRs operated at a paper transport speed of 5 centimeters per minute (300 cm/hr). These systems collected single event data consisting of maximum A-weighted Sound Level (AL), Sound Exposure Level (SEL), integration time (T), and equivalent sound level (LEQ).

The fourth microphone system was connected to a General Radio 1981B Sound Level Meter. This meter, used at site 7H for static operations only, provided A-weighted Sound Level values which were processed using a micro sampling technique to determine LEQ.

FIGURE 5.4

Acoustical Measurement Instrumentation

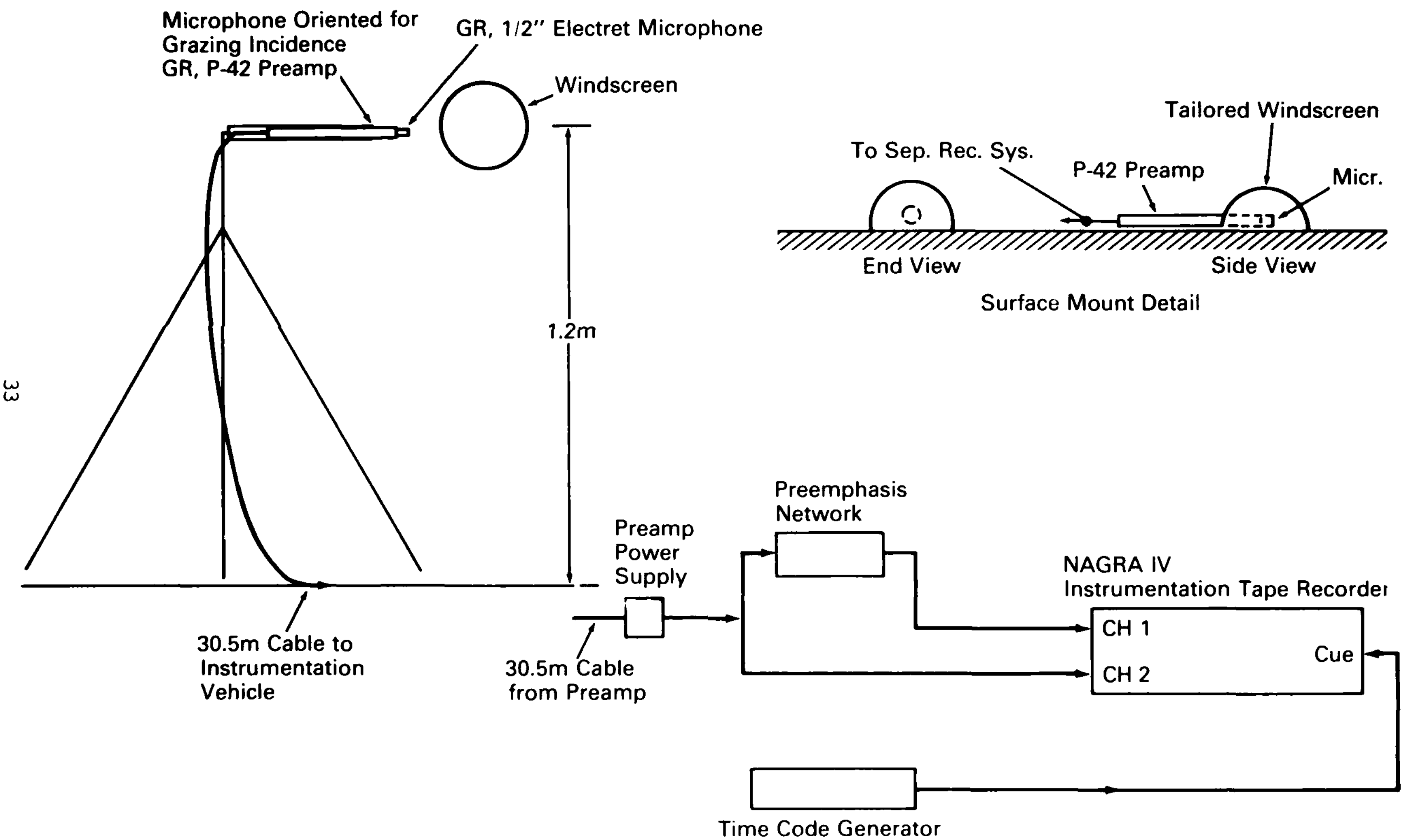
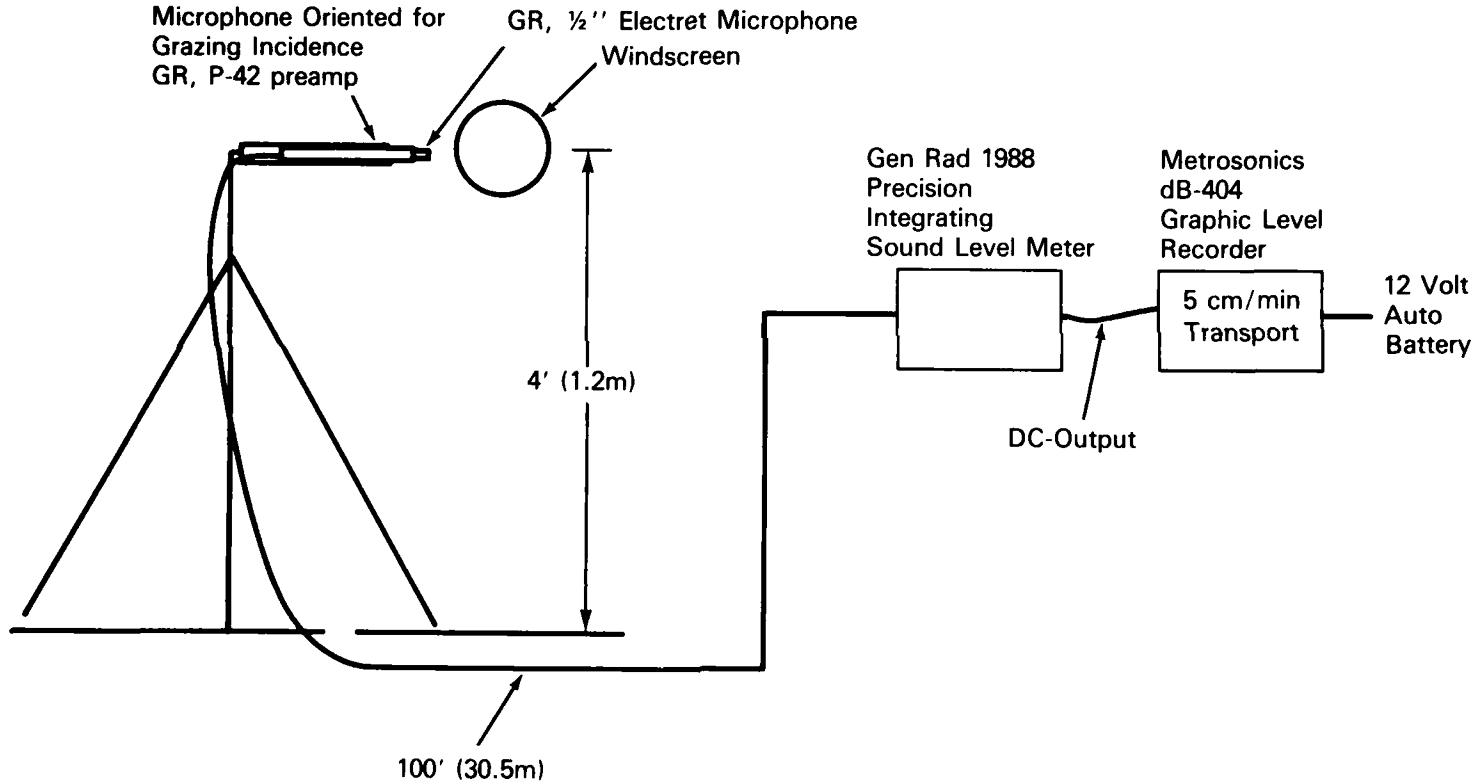


FIGURE 5.5

Acoustical Measurement Instrumentation



Direct Read Noise Measurement System

All instruments were calibrated at the beginning and end of each test day and approximately every hour in between. A schematic drawing of the basic direct read system is shown in Figure 5.5.

5.6.3 Deployment of Acoustical Measurement Instrumentation - This section describes the deployment of the magnetic tape recording and direct read noise measurement systems.

During the testing, TSC deployed six magnetic tape recording systems. During the flight operations, four of these recording system were located at the three centerline sites: one system at site 4, one at site 5, and two at centerline center with the microphone of one of those systems at 4 feet above ground, the microphone of the other at ground level. The two remaining recording systems were located at the two sidelines sites. The FAA deployed three direct read systems at the three centerline sites during the flight operations. Figure 5.6 provides a schematic drawing of the equipment deployment for the flight operations.

In the case of static operations, only four of the six recorder systems were used. The recorder system with the 4-foot microphone at site 1 moved to site 1H. The recorders at sites 4 and 5 moved to 4H and 5H respectively. The recorder at site 2, the south sideline site, was also used. The three direct read systems were moved from the centerline sites to sites 5H, 2, and 4H. The fourth direct read system was employed at site 7H. Figure 5.7 provides a schematic diagram of the equipment deployment for the static operations.

FIGURE 5.6

Microphone and Acoustical Measurement Instrument Deployment Flight Operations

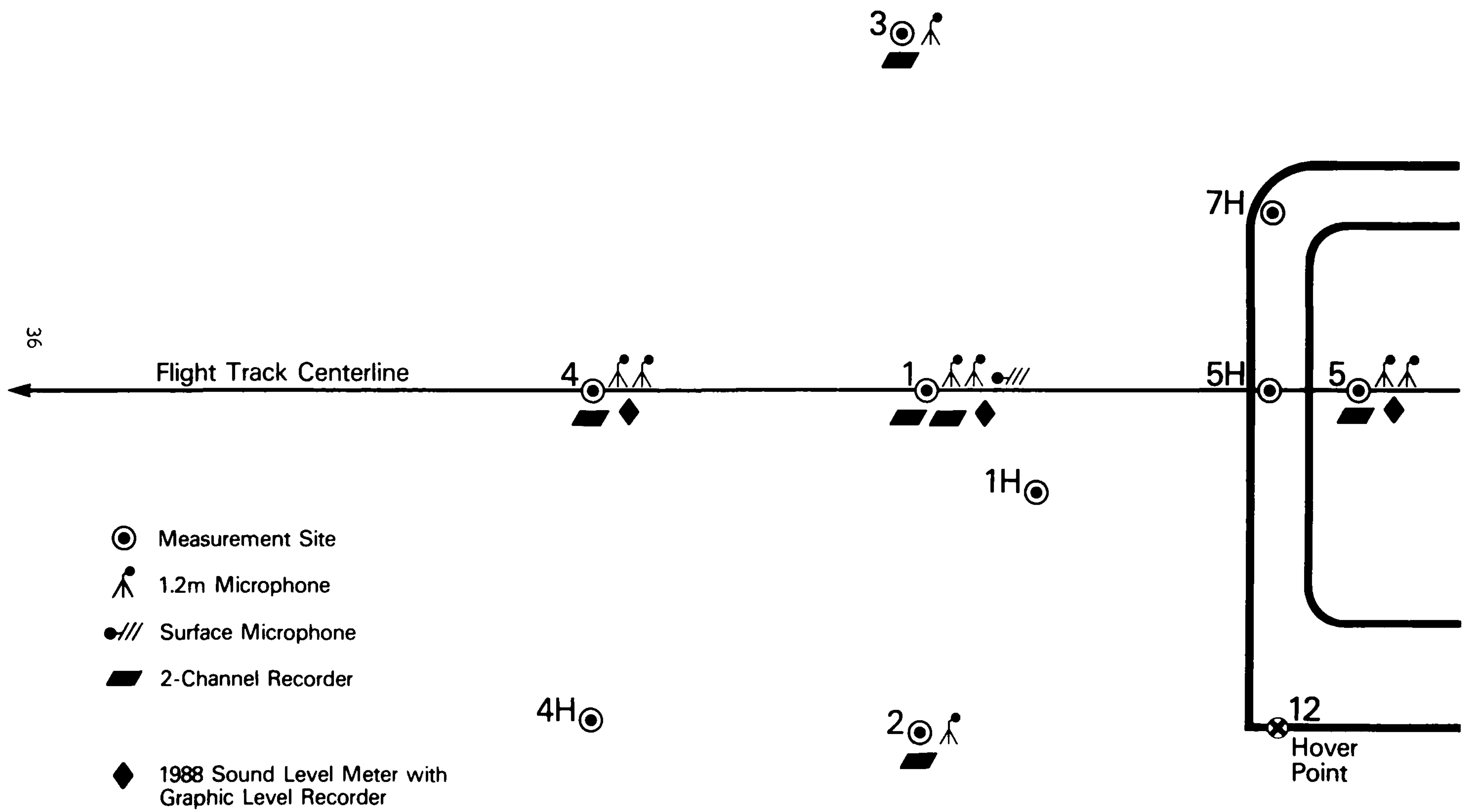
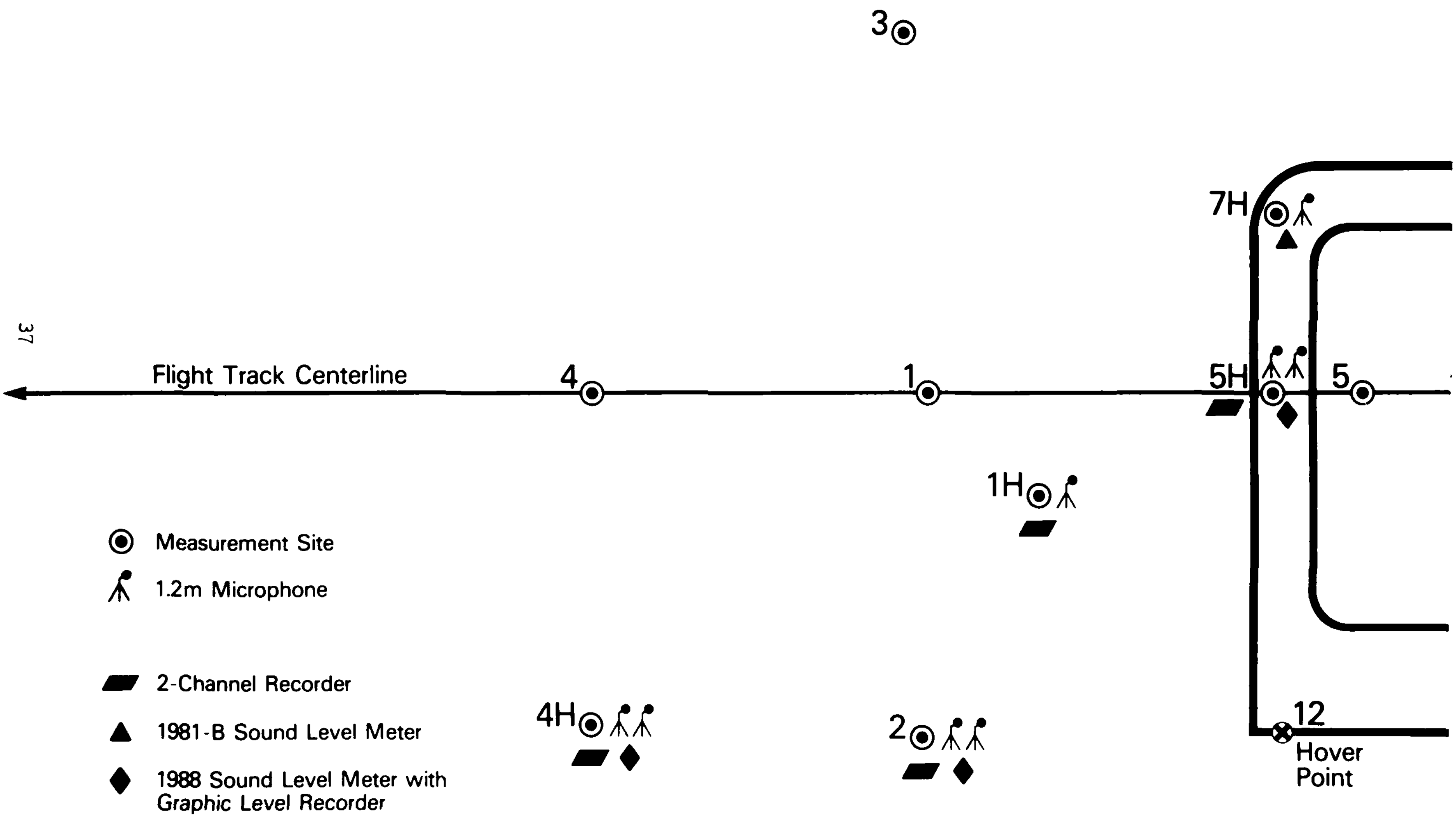


FIGURE 5.7

Microphone and Acoustical Measurement Instrument Deployment Static Operations



ACOUSTICAL DATA REDUCTION

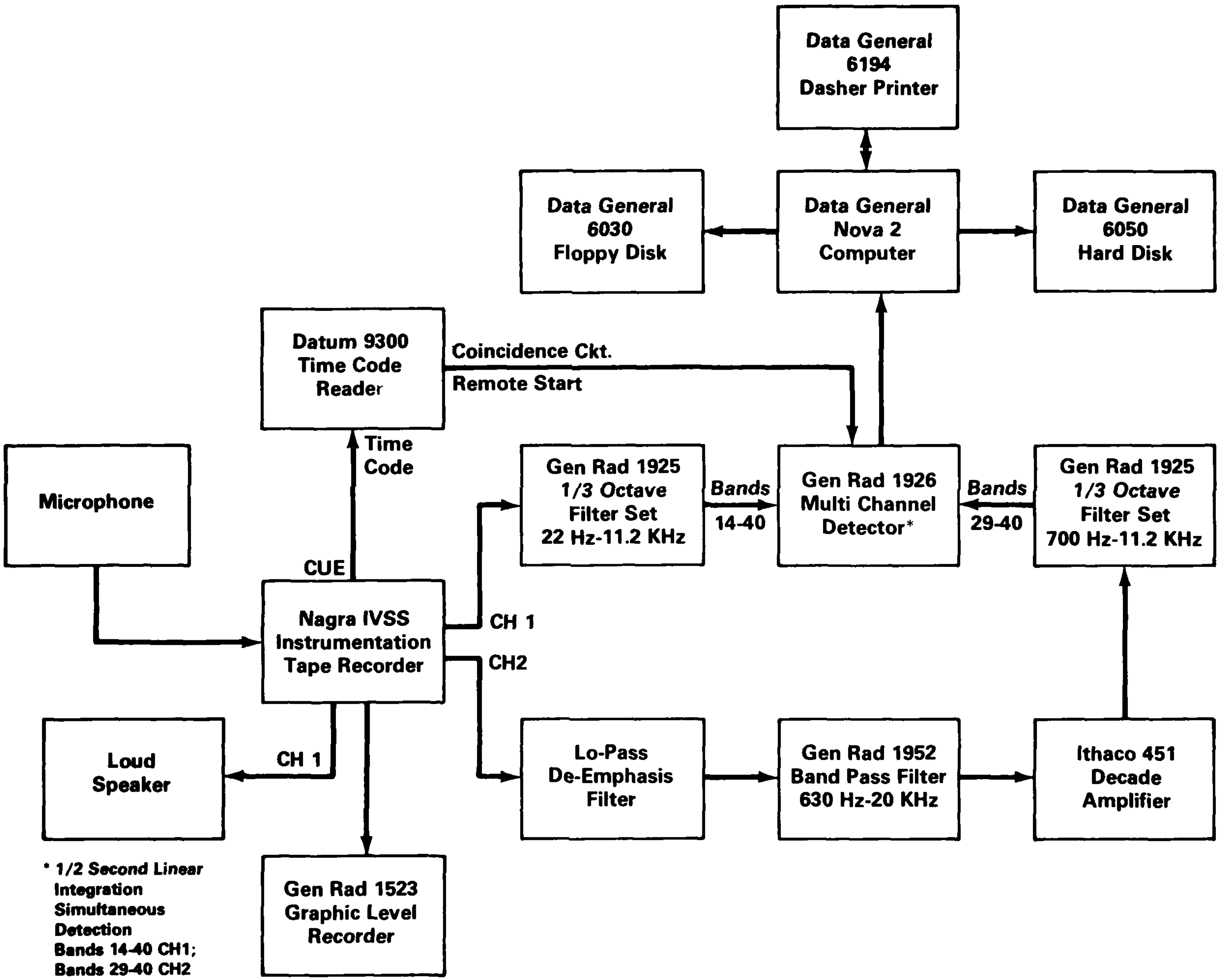
6.0 Acoustical Data Reduction - This section describes the treatment of tape recorded and direct read acoustical data from the point of acquisition to point of entry into the data tables shown in the appendices of this document.

6.1 TSC Magnetic Recording Data Reduction - The analog magnetic tape recordings analyzed at the TSC facility in Cambridge, Massachusetts were fed into magnetic disc storage after filtering and digitizing using the GenRad 1921 one-third octave real-time analyzer. Figure 6.1 is a picture of the TSC facility; Figure 6.2 provides a flow chart of the data collection, reduction and out process accomplish by TSC personnel. Recording system frequency response adjustments were applied, assuring overall linearity of the recording and reduction system. The stored 24, one-third octave sound pressure levels (SPLs) for contiguous one-half second integration periods making up each event comprise the base of "raw data." Data reduction followed the basic procedures defined in Federal Aviation Regulation (FAR) Part 36 (Ref. 3). The following sections describe the steps involved in arriving at final sound level values.

FIGURE 6.1

FIGURE 6.2

Acoustical Data Reduction/Instrumentation



6.1.1 Ambient Noise - The ambient noise is considered to consist of both the acoustical background noise and the electrical noise of the measurement system. For each event, the ambient level was taken as the five to ten-second time averaged one-third octave band taken immediately prior to the event. The ambient noise was used to correct the measured raw spectral data by subtracting the ambient level from the measured noise levels on an energy basis. This subtraction yielded the corrected noise level of the aircraft. The following execptions are noted:

1. At one-third octave frequencies of 630 Hz and below, if the measured level was within 3 dB of the ambient level, the measured level was corrected by being set equal to the ambient. If the measured level was less than the ambient level, the measured level was not corrected.

2. At one-third octave frequencies above 630 Hz, if the measured level was within 3 dB or less of the ambient, the level was identified as "masked."

6.1.2 Spectral Shaping - The raw spectral data, corrected for ambient noise, were adjusted by sloping the spectrum shape at -2 dB per one-third octave for those bands (above 1.25 kHz) where the signal to noise ratio was less than 3 dB, i.e., "masked" bands. This procedure was applied in cases involving no more than 9 "masked" one-third octave bands. The shaping of the spectrum over this 9-band range was conducted to minimize EPNL data loss. This spectral shaping methodology deviates from FAR-36 procedures in that the extrapolation includes four more bands than normally allowed.

6.1.3 Analysis System Time Constant/Slow Response - The corrected raw spectral data (contiguous linear 1/2 second records of data) were

processed using a sliding window or weighted running logarithmic averaging procedure to achieve the "slow" dynamic response equivalent to the "slow response" characteristic of sound level meters as required under the provisions of FAR-36. The following relationship using four consecutive data records was used:

$$L_i = 10 \text{ Log } [0.13(10.^{0.1L_{i}-3})+0.21(10.^{0.1L_{i}-2})+0.27(10.^{0.1L_{i}-1})+0.39)10.^{0.1L_{i})}]$$

where L_i is the one-third octave band sound pressure level for the ith one-half second record number.

6.1.4 <u>Bandsharing of Tones</u> - All calculations of PNLTM included testing for the presence of band sharing and adjustment in accordance with the procedures defined in FAR-36, Appendix B, Section B 36.2.3.3, (Ref. 6).

6.1.5 <u>Tone Corrections</u> - Tone corrections were computed using the helicopter acoustical spectrum from 24 Hz to 11,200 Hz, (bands 14 through 40). Tone correction values were computed for bands 17 through 40, the same set of bands used in computing the EPNL and PNLT. The initiation of the tone correction procedure at a lower frequency reflects recognition of the strong low frequency tonal content of helicopter noise. This procedure is in accordance with the requirements of ICAO Annex 16, Appendix 4, paragraph 4.3. (Ref. 7)

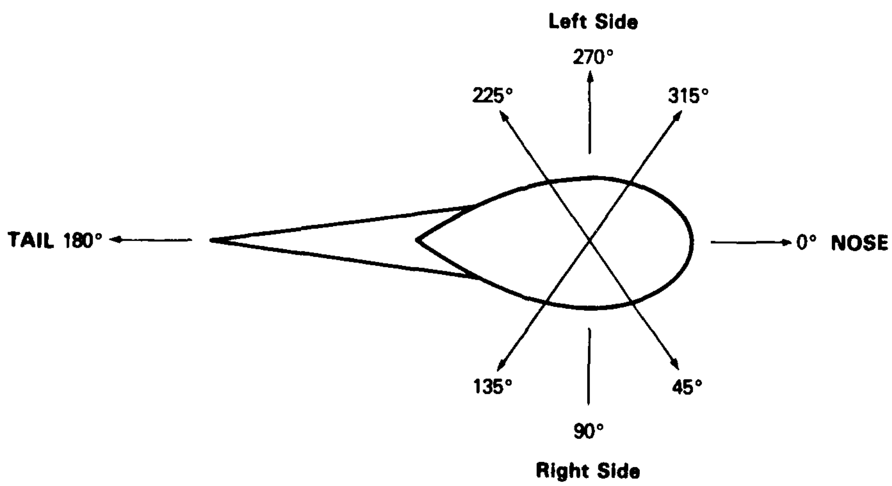
6.1.6 <u>Other Metrics</u> - In addition to the EPNL/PNLT family of metrics and the SEL/AL family, the overall sound pressure level and 10-dB down duration times are presented as part of the "As Measured" data set in Appendix A. Two factors relating to the event time history (distance duration and speed corrections, discussed in a later section) are also presented.

6.1.7 Spectral Data/Static Tests - In the case of static operations, thirty-two seconds of corrected raw spectral data (64 contiguous 1/2 second data records) were energy averaged to produce the data tabulated in Appendix C. The spectral data presented is "as measured" at the emission angles shown in Figure 6.3, established relative to each microphone location. Also included in the tables are the 360 degree (eight emission angles) average levels, calculated by both arithmetic and energy averaging.

Note that "masked" levels (see Section 6.1.1) are replaced in the tables of Appendix C with a dash (-). The indexes shown, however, were calculated with a shaped spectra as per Section 6.1.2.

FIGURE 6.3

Acoustical Emission Angle Convention



6.2 FAA Direct Read Data Reduction - Figure 6.4 provides a flow diagram of the data collection, reduction and output process effected by FAA personnel. FAA direct read data was reduced using the Apple IIe microcomputer and the VISICALC® software package. VISICALC® is an electronic worksheet composed of 256 x 256 rows and columns which can support mathematical manipulation of the data placed anywhere on the worksheet. This form of computer software lends itself

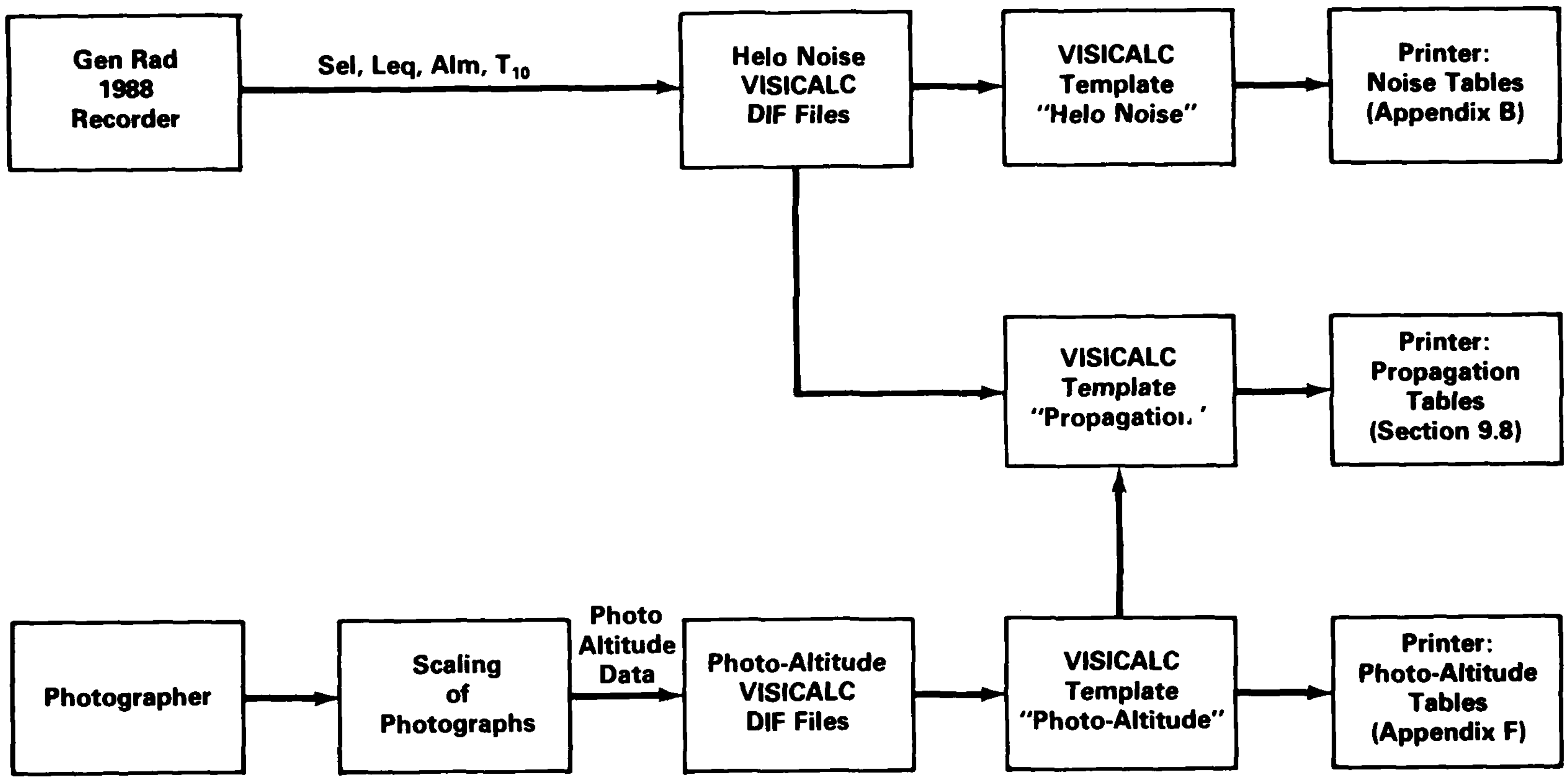
to a variety of data analyses, by means of constructing templates (worksheets constructed for specific purposes). Data files can be constructed to contain a variety of information such as noise data and position data using a file format called DIF (data interchange format).

Data analysis can be performed by loading DIF files onto analysis templates. The output or results can be displayed in a format suitable for inclusion in reports or presentations. Data tables generated using these techniques are contained in Appendices B and D, and are discussed in Section 9.0.

6.2.1 Aircraft Position and Trajectory - A VISICALC® DIF file was created to contain the photo altitude data for each event of each test series for the test conducted. These data were input into a VISICALC® template designed to perform a 3-point regression through the photo altitude data from which estimates of aircraft altitudes could be determined for each microphone location.

FIGURE 6.4

Direct Read Data Reduction



6.2.2 Direct Read Noise Data - Another template was designed to take two VISICALC® DIF files as input. The first contained the "as measured" noise levels SEL and dBA obtained from the FAA direct read systems and the 10-dB duration time obtained from the graphic level recorder strips, for each of the three microphone sites.

The second consisted of the estimates of aircraft altitude over three microphone sites. Calculations using the two input files determined two figures of merit related to the event duration influences on the SEL energy dose metric. This analysis is described in Section 9.4. All of the available template output data are presented in Appendix B.

TEST SERIES DESCRIPTION

7.0 Test Series Description - The noise-flight test operations schedule for the TwinStar consisted of two major parts.

The first part or core test program included the ICAO certification test operations (takeoff, approach, and level flyover) supplemented by level flyovers at various altitudes (at a constant airspeed) and at various airspeeds (at a constant altitude). In addition to the ICAO takeoff operation, a second, direct climb takeoff flight series was included. Alternative approach operations were also included, utilizing nine and twelve degree approach angles to compare with the six degree ICAO approach data.

The second part of the test program consisted of static operations designed to assess helicopter directivity patterns and examine ground-to-ground propagation.

The information presented in Table 7.1 describes the Hughes 500D test schedule by test series, each test series representing a group of similar events. Each noise event is identified by a letter prefix, corresponding to the appropriate test series, followed by a number which represents the numerical sequence of event (i.e., A1, A2, A3, A4, B5, B6,...etc.). In some cases the actual order of test series may not follow alphabetically, as a D1, D2, D3, D4, E5, E6, E8, H9, H10, H11,... etc.). In the case of static operations the individual events are reported by the acoustical emission angle referenced to each individual microphone location (i.e., J120, J165, J210, J255, J300, J345, J030, J75). In Table 7.1, the test target operational parameters for each series are specified along with approximate start and stop times. These times can be used to reference

corresponding meteorological data in Appendix G. Timing of fuel breaks are also identified so that the reader can estimate changes in helicopter weight with fuel burn-off. Actual operational parameters and position information for specific events are specified in the appendices of this document.

The "standard takeoff" operation, elected by the manufacturer, consisted of a direct climbout from a 5-foot hover, using the best angle of climb. The reader is referred to Appendices E and F for appropriate cockpit instrument and trajectory information necessary to fully characterize this operation.

Figures 7.1, 7.2 and 7.3 present the test flight configuration for the takeoff, approach and level flyover operations. A schematic of the actual flight tracks is available in Figure 3.3.

TABLE 7.1

TEST SUMMARY

AEROSPATIALE AS-355F TWIN STAR

TEST SERIES RUN NOS.	DESCRIPTION OF SERIES	START TIME	FINISH TIME	NOTES
I	Hover in ground effect	6:05 am	6:17 am	8 Dir Angles
J(A)	Static/Flight Idle RPM	6:20 am	6:43 am	8 Dir Angles
J(B)	Static/Ground Idle RPM	6:20 am	6:43 am	8 Dir Angles
K	Hov out of Grd Effect	6:44 am	6:57 am	8 Dir Angles
DUE TO POOR VISIBILITY THE TEST PROGRAM WAS DELAYED				
A/A1-A6	LFO, 500 Ft/0.9 VH	7:56 am	8:08 am	
B/B7-B13	LFO, 500 Ft/0.8 VH	8:11 am	8:26 am	
C/C15-C18	LFO, 500 Ft/0.7 VH	8:33 am	8:46 am	
D/D19-D25	LFO, 1000 Ft/0.9 VH	8:48 am	9:04 am	
E/E26/E33	ICAO Takeoff, 63 MPH	9:06 am	9:43 am	
FUEL BREAK				
H/H34-H37	9 Deg Approach, 75 MPH	10:32 am	10:44 am	
G/G38-G41	Takeoff "STD"	10:49 am	10:59 am	
F/F42-F48	6 Deg Approach, 63 MPH	11:07 am	11:30 am	
M/M49-M53	LFO, 500 Ft/146 MPH VH	11:39 am	11:49 am	
N/N54-N56	LFO, 500 Ft/86 MPH	11:52 am	11:58 am	

FIGURE 7.1

Helicopter Takeoff Noise Tests

The take-off flight path shall be established as follows:

a) the helicopter shall be established in level flight at the best rate of climb speed, V_y, $\pm$ 3 knots, of the maximum speed of the curve contignous to the ordinated of the limiting height-speed envelope + 3 knots ($\pm$3 knots), whichever is greater, and, at a height of 20 m (66 ft) above the ground until a point 500 m (1,640 ft) before the flight path reference point is reached;

b) upon reaching the point specified in a) above, the power shall be increased to maximum take-off power and a steady climb initiated and maintained over the noise measurement time period;

c) airspeed established in a) above shall be maintained throughout the take-off reference procedure;

d) the steady climb shall be made with the rotor speed stabilized at the maximum rpm for power-on operations

e) a constant take-off configuration selected by the applicant shall be maintained throughout the take-off reference procedure except that the landing gear may be retracted; and

f) the weight of the helicopter shall be the maximum take-off weight.

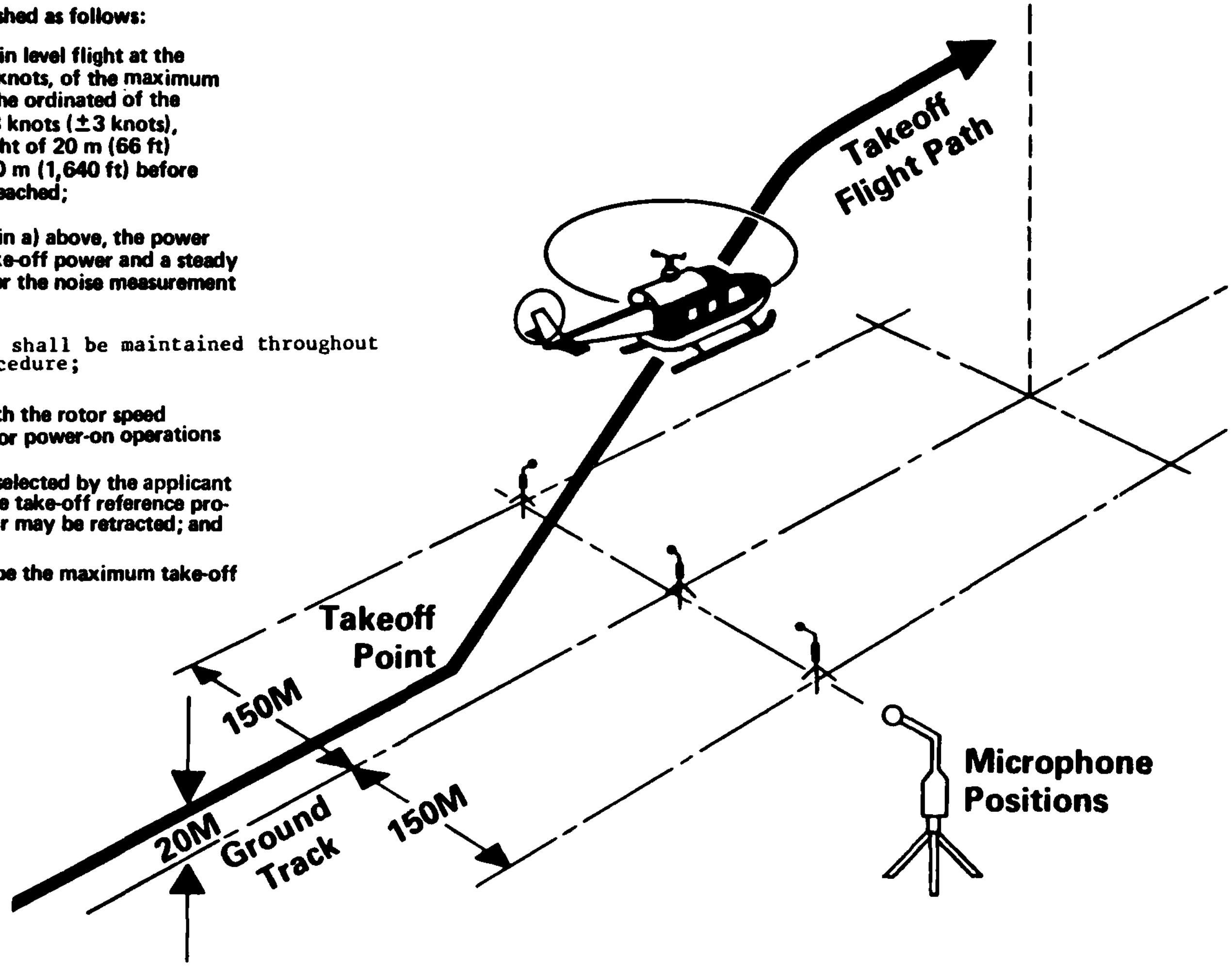


FIGURE 7.2

Helicopter Approach Noise Tests

The approach procedure shall be established as follows:

a) the helicopter shall be stabilized and following a 6.0° approach path;

b) the approach shall be made at a stabilized airspeed equal to the best rate of climb speed V_y, ± 3 knots, or the maximum speed of the curve contiguous to the ordinate of the limiting height-speed envelope + 3 knots (± 3 knots), whichever is the greater, with power stabilized during the approach and over the flight path reference point, and continued to 50 feet above ground level

c) the approach shall be made with the rotor speed stabilized at the maximum rpm for power-on operations.

d) the constant approach configuration used in airworthiness certification tests, with the landing gear extended, shall be maintained throughout the approach reference procedure; and

e) the weight of the helicopter shall be the maximum landing weight

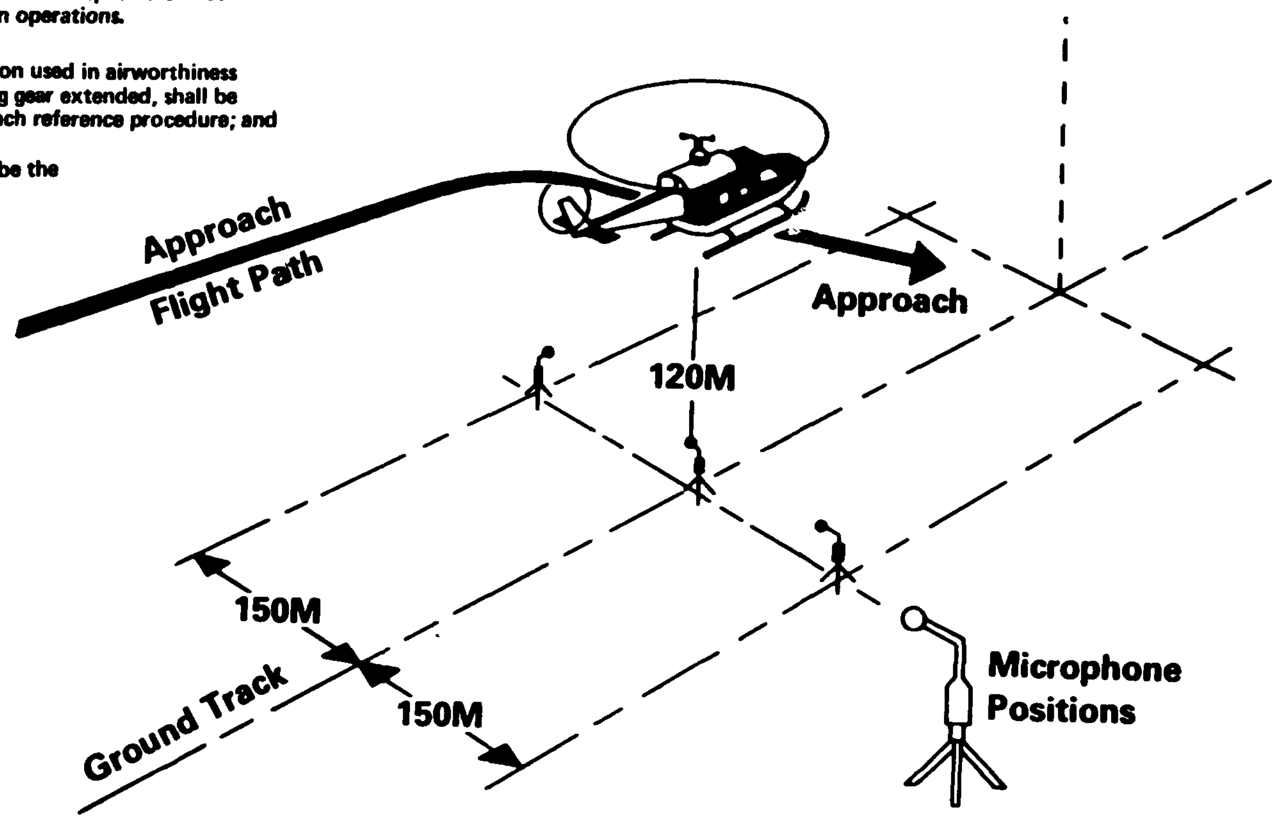


FIGURE 7.3

Helicopter Flyover Noise Tests

The flyover procedure shall be established as follows:

a) the helicopter shall be stabilized in level flight overhead the flight path reference point at a height of 150 m (492 ft);

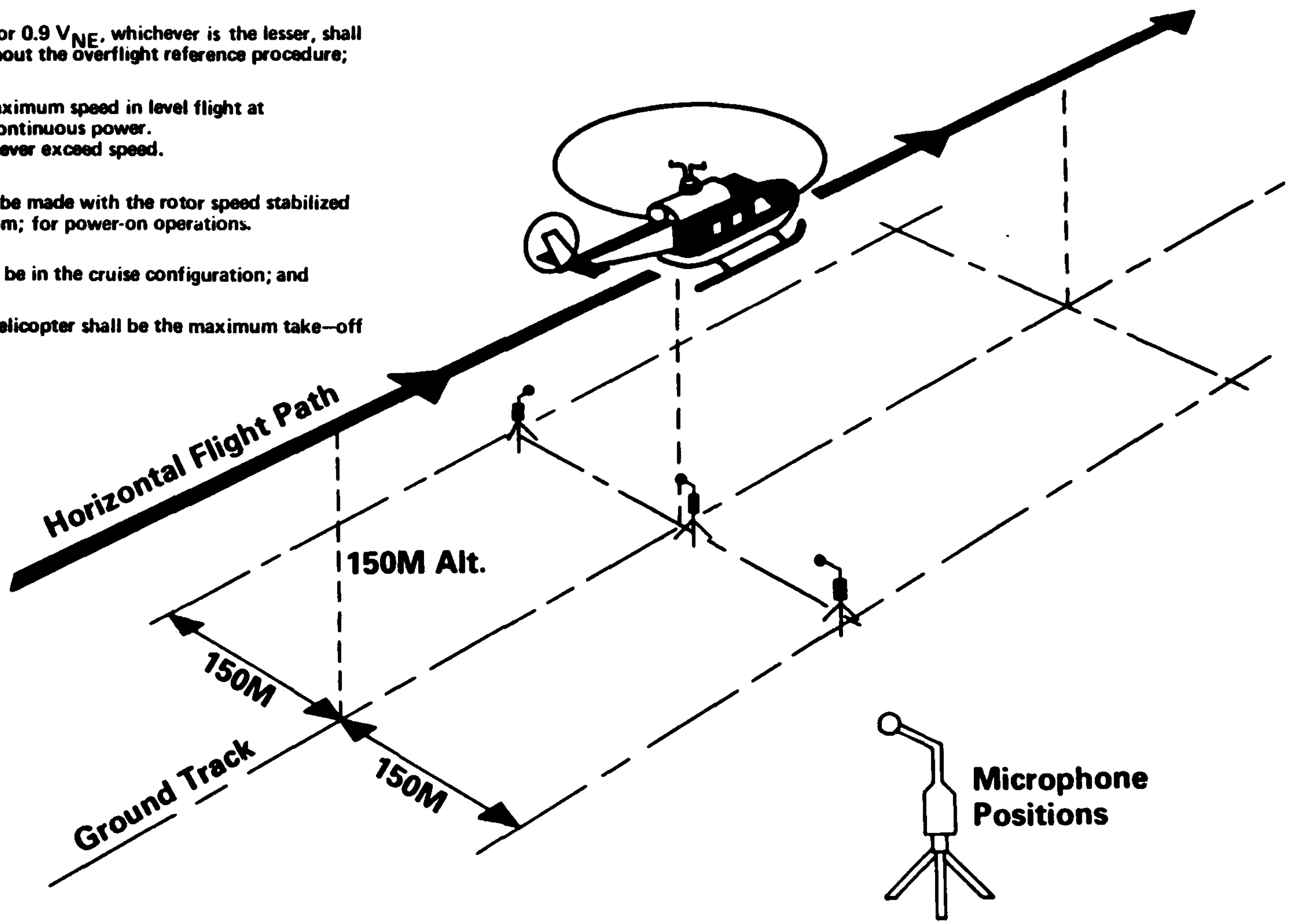
b) a speed of 0.9 V_H or 0.9 V_{NE}, whichever is the lesser, shall be maintained throughout the overflight reference procedure;

NOTE: V_H is the maximum speed in level flight at maximum continuous power.
V_{NE} is the never exceed speed.

c) the overflight shall be made with the rotor speed stabilized at the maximum rpm; for power-on operations.

d) the helicopter shall be in the cruise configuration; and

e) the weight of the helicopter shall be the maximum take-off weight.



DOCUMENTARY ANALYSES

8.0 Documentary Analyses/Processing of Trajectory and Meteorological Data - This section contains analyses which were performed to document the flight path trajectory and upper air meteorological characteristics during the TwinStar test program.

8.1 Photo-Altitude Flight Path Trajectory Analyses - Data acquired from the three centerline photo-altitude sites were processed on an Apple IIe microcomputer using a VISICALC® (manufacturer) electronic spreadsheet template developed by the authors for this specific application. The scaled photo-altitudes for each event (from all three photo sites) were entered as a single data set. The template operated on these data, calculating the straight line slope in degrees between the helicopter position over each pair of sites. In addition, a linear regression analysis was performed in order to create a straight line approximation to the actual flight path. This regression line was then used to compute estimated altitudes and CPA's (Closest Point of Approach) referenced to each microphone location (Note: Photo sites were offset from microphone sites by 100 feet). The results of this analysis are contained in the tables of Appendix F.

Discussion - While the photo-altitude data do provide a reasonable description of the helicopter trajectory and provide the means to effect distance corrections to a reference flight path (not implemented in this report), there is the need to exercise caution in interpretation of the data. The following excerpt makes an important point for those trying to relate the descent profiles (in approach test series) to resulting acoustical data.

> In our experience, attempts by the pilot to fly down a very narrow VASI beam produce a continuously varying rate of descent. Thus while the mean flight path is maintained within a reasonable degree of test precision, the rate of descent (important parameter connected with blade/vortex interactions) at any instant in time may vary much more than during operational flying. (Ref. 8)

Further, care is necessary when using the regression slope and the regression estimated altitudes; one must be sure that the site-to-site slopes are similiar (approximate constant angle) and that they are in agreement with the regression slope. If these slopes are not in agreement, then use photo altitude data along with the site-to-site slopes in calculating altitude over microphone locations. Also included for reference are the mean values and standard deviations for the data collected at each site, for each series. These data display the variability in helicopter position within a given test series.

8.2 Upper Air (500-2000 ft) Meteorological Data - This section documents the coarse variation in upper air meteorological parameters as a function of time for the June 7 test program. References are also made to surface meteorological data.

The National Weather Service office in Sterling, Virginia provided preliminary data processing resulting in the data tables shown in Appendix H. Supplementary analyses were then undertaken to develop time histories of various parameters over the period of testing for selected altitudes. Each time history was constructed using least square linear regression techniques for the five available data points (one for each launch). The plots attempt to represent the gross (macro) meteorological trends over the test period.

Temperature - Figure 8.1 shows the time history of temperature (degree Celsius) for June 7, 1983. Between the hours of 7 and 9 a.m. we see a slight temperature inversion up to the 500-foot level, concurrent with static and level flyover portions of the test. Aside from the presence of this inversion layer, the air mass tends to be stable with a normal lapse rate as one would expect for a typical summer day, with gradual warming of the earth's surface as a function of time. For the takeoff/approach portion of this test, only surface meteorological data were available. National Weather Service records show surface temperatures on the order of 20 - 30°C for these test series.

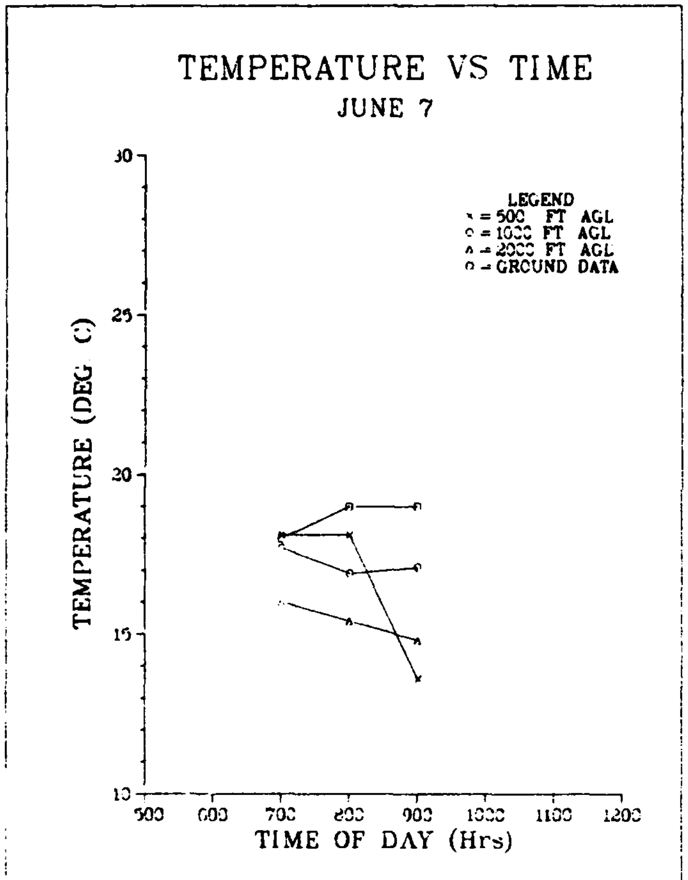


FIGURE 8.1

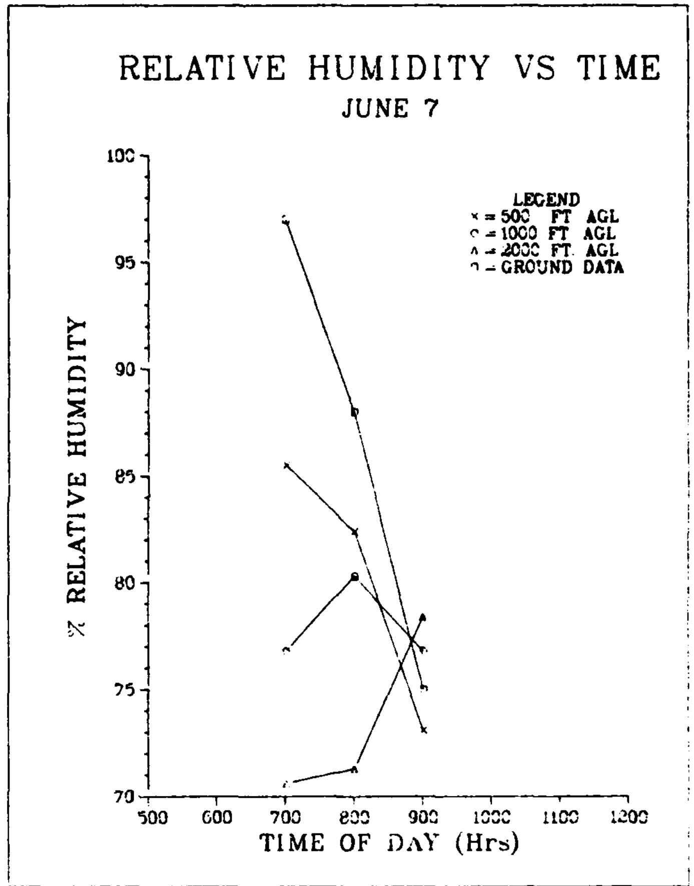


FIGURE 8.2

Relative Humidity - Figure 8.2 shows the (7-9 a.m.) time history of relative humidity for June 7. From the figure, it can be seen that a decrease in surface RH from 97% at 7 a.m. to 75% at 9 a.m. existed which coincides with the expected burnoff of grounde moisture with solar heating of the earth's surface. Similar decreases occur at the higher altitudes as the figure shows.

The primary concern with relative humidity is its influence in controlling atmospheric absorption of sound. In considering a center frequency of 500 Hz we see from reference ARP 886 (Ref.) that a constant absorption coefficient is applicable for the stated range percent relative humidity. The reader may consider undertaking a more extensive assessment of absorption influences.

Wind Data - Figure 8.3 and 8.4 show the time history of the wind velocity from 7 a.m. to 9 a.m. on June 7. Figure 8.3 shows the magnitude of the head/tail wind component (5 to 10 knots), while figure 8.4 shows the magnitude of the cross wind component (approximately 7 knots). These wind conditions as reported existed during the level flyover portion of the test. The reader should note that wind direction (and its influence as a head or tail wind) is related to the helicopter heading. During the test, level flyover operations were conducted alternately in the 300 - 120° directions to facilitate quick turnaround times between events.

During the takeoff/approach portion of this test, only surface meteorological data from the National Weather Service were available. Examination of this data reveals ground winds on the order of 10 knots from the 330 direction, creating a headwind condition for takeoffs and a tailwind condition for approaches.

Discussion - In the context of a noise measurement/flight test one attempts to avoid so-called anomalous meteorological conditions, (see ref. 3) a concept that is difficult to define. Although the reasons behind the requirement to avoid "anomalous conditions" arose from concerns involved with atmospheric absorption, one might extend the requirement to include concerns for smooth flight, and normal attitudinal operation of the helicopter. While extreme cross wind components and/or strong shifts in wind in the vicinity of the test site might suggest the presence of buffeting or turbulance, it is primarily the pilot's reported ease or difficulty in flying the helicopter which identifies a potential problem. While the data do suggest the presence of variation in wind speed and direction (and the presence of moderate wind strength) they do not connote extreme conditions which might lead to senous concern. Most importantly there were no pilot reports of turbulence or difficulty in flight control.

As a final note, the influence of wind on blade-vortex interactions (a strong function) cannot be completely addressed using the data presented in this section. Rather, it is necessary to acquire data virtually concurrent with the flight operations and in very close proximity to the test helicopter. It is anticipated that future tests will employ tethered ballon systems or acoustical sounding, SODAR systems in close proximity to the test area.

HEAD/TAIL WIND

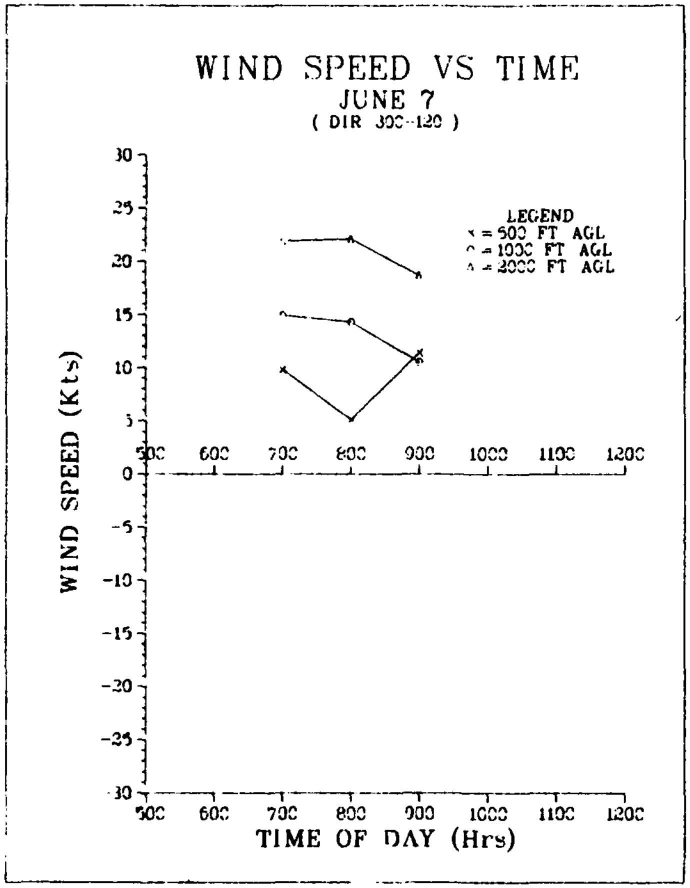


FIGURE 8.3

This plot indicates a headwind for operations in the 300 degree magnetic direction.

CROSS WIND

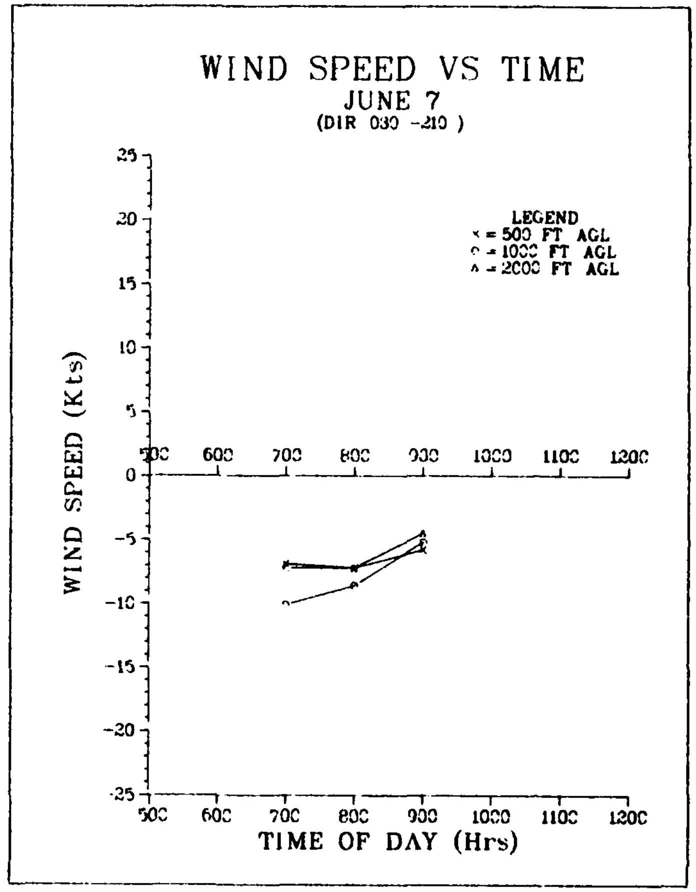


FIGURE 8.4

This plot indicates a right side corsswind for operations in the 120 degree magnetic direction.

EXPLORATORY ANALYSES AND DISCUSSIONS

9.0 Exploratory Analyses and Discussion - This section is comprised of a series of distinct and separate analyses of the data acquired during the Aerospatiale TwinStar noise measurement program. In each analysis section an introductory discussion is provided describing pre-processing of data (beyond the basic reduction previously described), followed by presentation of either a data table, graph(s), or reference to appropriate appendices. Each section concludes with a discussion of salient results and presentation of conclusions.

The following list identifies the analyses which are contained in this section.

- 9.1 Variation in noise levels with airspeed for level flyover operations
- 9.2 Static data analysis: source directivity and hard vs. soft propagation characteristics
- 9.3 Comparison of noise data: 4-foot vs. ground microphones
- 9.4 Duration effect analysis
- 9.5 Analysis of variability in noise levels for two sites equidistant over similar propagation paths
- 9.6 Variation in noise levels with airspeed and rate of descent for approach operations
- 9.7 Analysis of ground-to-ground acoustical propagation for a nominally soft propagation path
- 9.8 Air-to-ground acoustical propagation analysis

9.1 <u>Variation in Noise Levels with Airspeed for Level Flyover Operations</u> - This section analyzes the variation in noise levels for level flyover operations as a function of airspeed. Data acquired from the centerline-center location (site 1) magnetic recording system (see Appendix A) have been utilized in this analysis. All data are "as measured", uncorrected for the minor variations in altitude from event to event.

The data scatter plotted in Figures 9.1 through 9.4 represent individual noise events (for each acoustical metric). The line in each plot links the average observation at each target airspeed.

<u>Discussion</u> - The plots show the general trend that can be expected with an increase in airspeed during level flyover operations. It has been observed that as a helicopter increases its airspeed, two acoustically related events take place. First, the noise event duration is decreased as the helicopter passes more quickly. Second, the source acoustical emission characteristics change. These changes reflect the aerodynamic effects which accompany an increase in speed. At speeds higher than the speed for minimum power, the power required (torque) increases with an increase in airspeed. These influences lead to a noise intensity versus airspeed relationship generally approximated by a parabolic curve. At first, noise levels decrease with airspeed, then an upturn occurs at as a consequence of increasing advancing blade tip Mach number effects, which in turn generate impulsive noise.

The noise versus airspeed plots for the Aerospatiale TwinStar are shown for various acoustical metrics in Figures 9.1 through 9.4. The TwinStar

noise level relationships follow a generally parabolic pattern (plotted as straight line segments) characterized by a sharp upturn in noise level at approximately 120 mph. A similar curve shape is ovserved for each metric. This airspeed is equivalent to a translational Mach Number of 0.155 (120 mph x 1.467/1135.6) This airspeed dependent Mach Number increases by 0.013 for every 10 mph increase in airspeed. The rotational Mach Number remains relatively constant at .6371 ((394 rpm/60) x (PI x 35.07)/1135.6). Advancing tip Mach Number relationships corresponding to airspeeds are presented in the table below. The point of inflection in the noise level airpseed relationship is therefore associated with an advancing tip Mach Number of approximately 0.79. From this point forward, noise level increases approximatley 3 dB per 10 mph (3 dB/0.013 change in Mach Number).

Table 9.1

IAS (MPH)	M_A
90	.753
100	.766
110	.779
120	.792
130	.805
140	.818
150	.831

TwinStar Level Flyover Plots

FIGURE 9.1

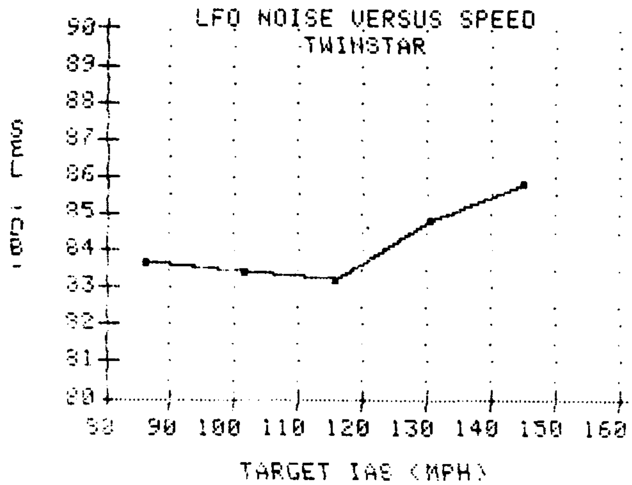


FIGURE 9.2

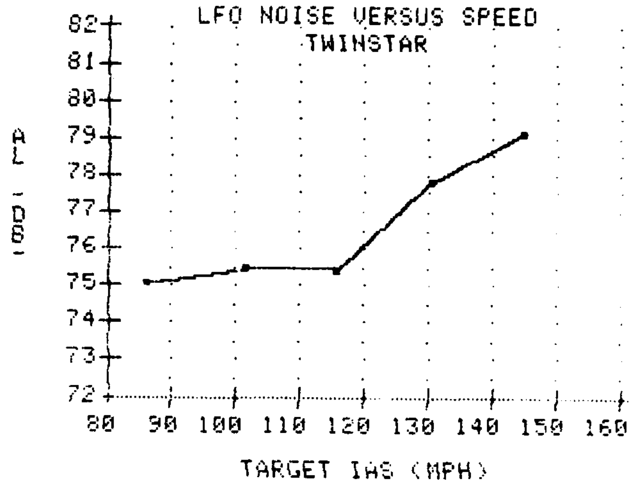


FIGURE 9.3

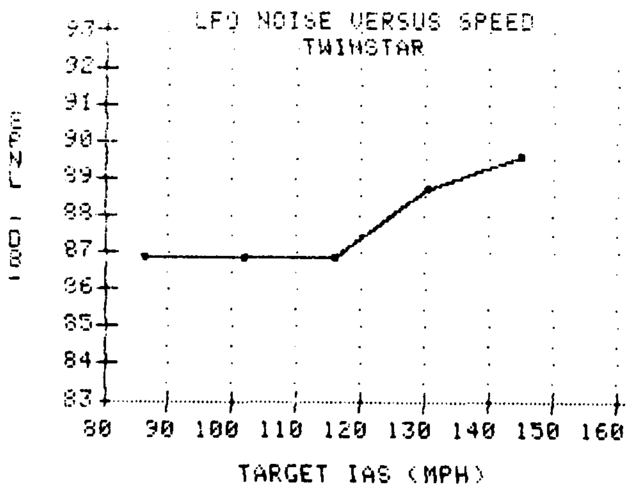
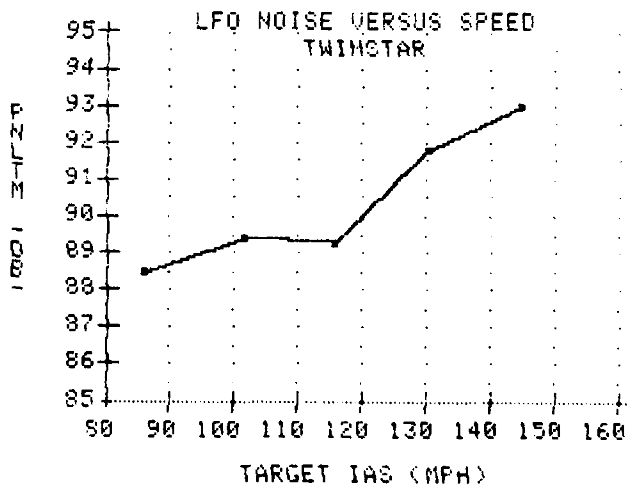


FIGURE 9.4



9.2 Static Operations: Analysis of Source Directivity and Hard vs. Soft Path Propagation Characteristics - This analysis is comprised of two principal components. First, the plots shown in Figures 9.5 through 9.8 depict the time averaged directivity patterns for various static operations for measurement sites located equidistant from the hover point. The second component involves the fact that one of the two sites lies separated from the hover point by a hard concrete surface, while the other site is separated from the hover point by a soft grassy surface. The difference in the propagation of sound over the two disparate surfaces is reflected in the difference between the upper and lower curves in each plot. A figure (Figure 9.9) is provided showing the microphone positions and the hard and soft paths at the end of this section.

Time averaged (approximately 60 seconds) data are shown for acoustical emission directivity angles (see Figure 6.1) established every 45 degrees from the nose of the helicopter (zero degrees), in a clockwise fashion. Magnetic recording data plotted in these figures can be found in Appendix C for microphones 5H and 2. A schematic of the typical hover-in-ground effect measurement configuration is shown in Figure 9.9.

Discussion - The following paragraphs highlight salient features associated with static test data.

HIGE - Noise data collected for the Hover-In-Ground-Effect operation are shown in Figure 9.5. The TwinStar displays an acoustical radiation pattern that is dominant on the left side of the aircraft. The minimum and maximum noise levels occur for the 0 and 180 degree emission angles corresponding to the nose and engine exhaust port respectively (see Figure 1.1).

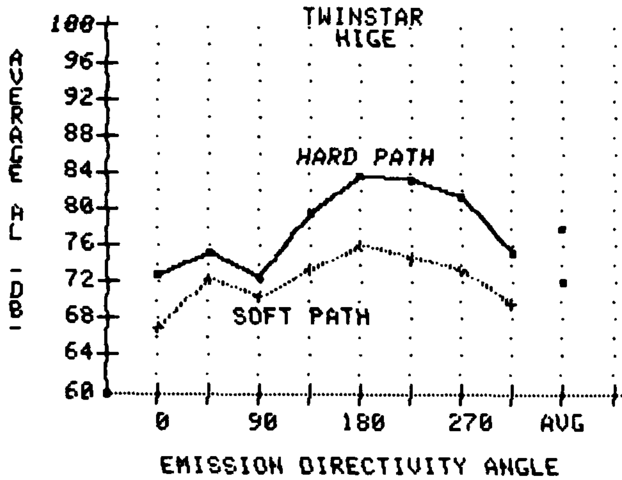


FIGURE 9.5

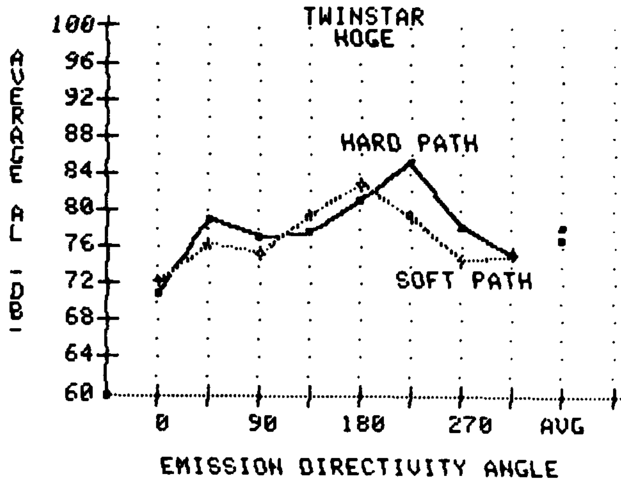


FIGURE 9.6

Further, examination reveals that this left side dominance in emission pattern cannot be attributed to placement of tail rotor system, but is possibly due to the clockwise rotating main rotor interacting with previously generated vortices. The average difference in noise levels (hard versus soft path) is 6 db, clearly underscoring the influence of surface characteristics on noise propagation.

<u>HOGE</u> - Noise data collected for the Hover-out-of-ground effect (HOGE) operation are shown in Figure 9.6. As found for the HIGE operation, the HOGE operation also displays an acoustic radiation pattern that is dominant at the left side of the aircraft. The minimum and maximum noise levels are associated with the 0 and 225 degree emission angles corresponding to the nose and left rear quadrant. The average difference in noise levels propagated across hard and soft paths is 6 dB, reflecting the influence of surface characteristics on the propagation of sound.

Further examination of Figure 9.6 reveals that for 2 emission angles (135 and 180 degrees), the noise levels measured for the soft path are 2 to 3 dB greater tha those for the hard path. This anomolous result is likely associated with variant meterological conditions (especially wind) influencing blade-vortex interactions.

Flight Idle - Noise data for the flat pitch, flight idle (FI) operation are shown in Figure 9.7. This figure displays the same trend that has been observved for other static operations in regard to acoustic emission radiation pattern. However, for the FI operation, we see the maximum noise levels occurring at the 270 degree emission angle, corresponding to the left side of the aircraft. An interesting point worth noting is that the 180 degree emission angle, corresponding to the engine exhaust ports is 2 to 3 dB less in noise levels than the right side of the aircraft where the tail rotor system is mounted.

Ground Idle - Figure 9.8 shows data collected for four directivity angles for the relatively quiet ground idle operation. Significant differences are observed in average sound level are for the two different paths under consideration underscoring the significant role that ground surface characteristics can play in heliport planning. While some differences are observed in the directivity of acoustical radiation the overall pattern is smoother and less characterized by sharp nodes and maxima.

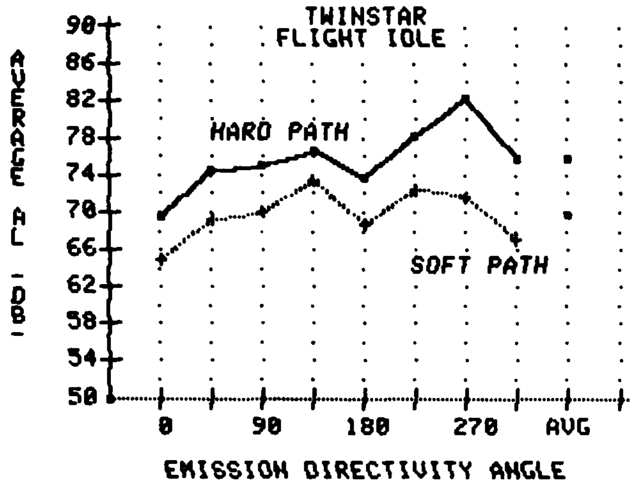


FIGURE 9.7

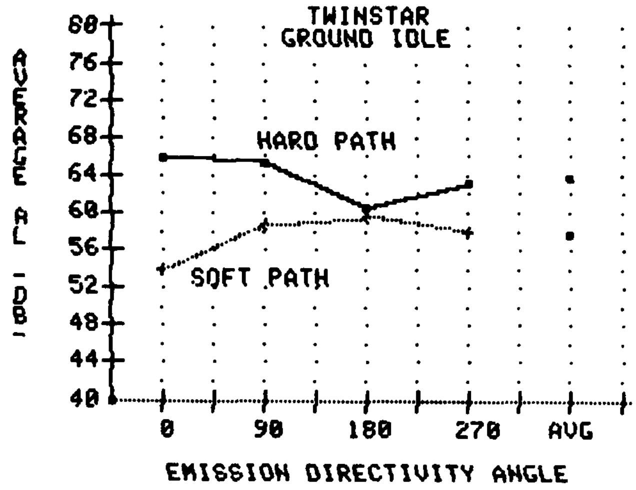


FIGURE 9.8

Environmental Impact - The table shown below presents observations concerning noise impact and acceptability based on consideration of typical urban/community ambient noise levels and the levels or urban transportation noise sources. Interpretations assume that event durations reflect static operational scenarios (usually one minute to 15 minutes). In general, the interpretation of environmental impact requires careful consideration of the ambient sound levels in the vicinity of the specific heliport under consideration. A useful document for further interpretation is Reference 9.

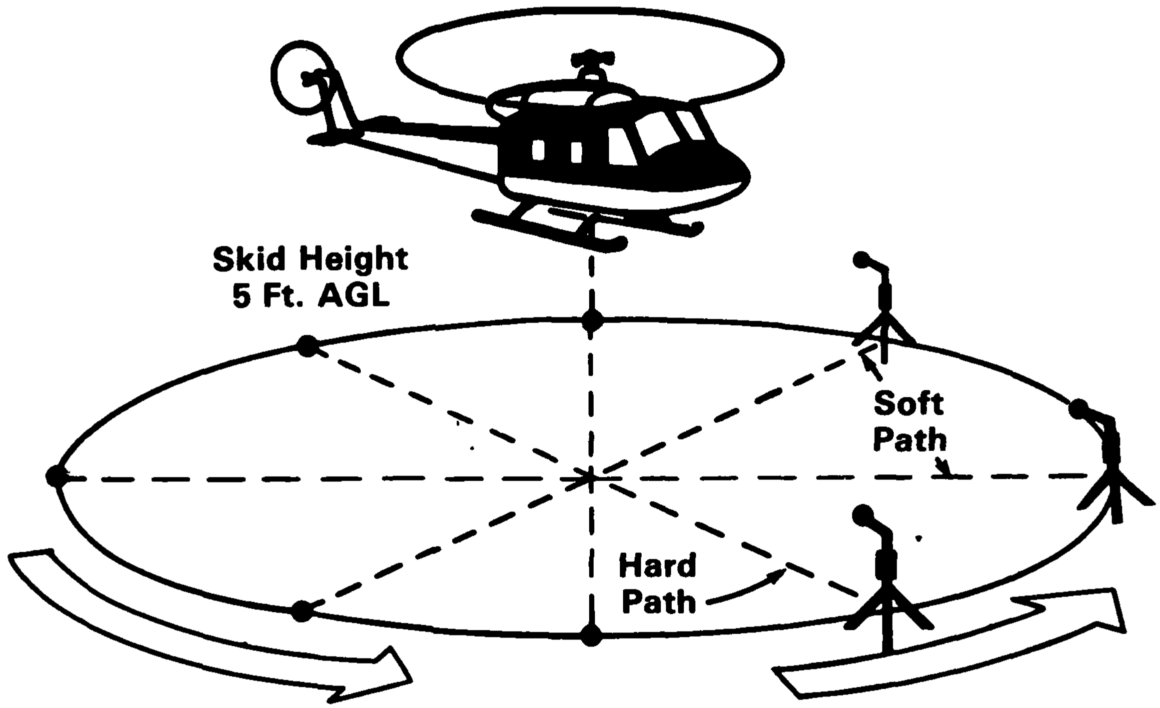
TABLE 9.2

A-Weighted Noise Level Ranges

60 dB	-	Urban ambient noise level
Mid 60's	-	Urban ambient noise level
70 dB	-	Noise level of minor concern
Mid 70's	-	Moderately intrusive noise level
80 dB	-	Clearly intrusive noise level
Mid 80's	-	Potential Problems due to noise
90 dB	-	Noise level to be avoided for any length of time.

FIGURE 9.9

Helicopter Hover Noise Test



Helicopter Rotates in 45° Steps
8 Microphone Positions

9.3 Comparison of Measured Sound Levels: 4 Foot vs. Ground Microphones - This analysis addresses the comparability of noise levels measured at ground level and at 4 feet above the ground surface. The topic is discussed in the context of noise certification testing requirements. The analysis involves examination of differences between noise levels acquired for ground mounted and 4-ft mounted microphone systems. The objectives of this analysis are as follows: 1) observe the value and variability of ground/4-ft microphone differences and identify the degree of phase coherence and 2) examine the variation with operational configuration.

The data employed in this analysis are from the microphone site #1 magnetic recording system (Appendix A). The mean differences between the ground and four foot microphones are shown in Table 9.3 for eight different test series.

In conducting this analysis, our initial assumption was that the ground-mounted microphone experiences phase coherent pressure doubling (a reasonable assumption at the frequencies of interest). At the 4-foot microphone, one would expect to see a lower value, somewhere within the range of 0 to 3 dB, depending on the degree of random verses coherent phase between incident and reflected sound waves. It is also possible to experience phase cancellation between the two sound paths. If cancellation occurs at dominant frequencies, then one is likely to observe noise levels at the 4-foot microphone more than 3 dB below the ground microphone values. In fact, data presented in this section display

significant cancellation with instances of 5.7 dB (weighted metric) lower levels at the 4-foot microphone. Figure 9.10 provides a schematic of the various "difference regions" associated with different relationships between incident and reflected sound waves.

Discussion - It is argued that acquisition of data from ground-mounted microphones provides a cleaner spectrum, closer to the spectrum actually emitted by the helicopter--that is, not influened by a mixture of constructive and destructive ground reflections. Theoretically, one would be interested in correcting ground-based data to levels expected at 4 feet or vice versa in order to maintain equally stringent regulatory policy. In other words, to change a certification limit at a 4-ft microphone to fit a ground-based microphone test, one theoretically would have to increase the limit by an amount necessary to maintain equal stringency.

Examination of the results in Table 9.3 show that most differences do fall between 3 and 5 dB. These results are consistent with theory and suggest that a degree of cancellation typiclly accompanies the 3 dB difference one would expect for random versus coherent phase relationships.

The variability in test results between operations modes displays no clear pattern. The variation in difference in values can be considered to reflect differences in the "acoustical angle" or the angle of incidence at the time of the maximum noise. These geometrical factors are also joined by differences in spectral content in influencing resulting sound level values. A narrow band analysis of the data would identify the specific frequencies where cancellation and reinforcement effects are present (and dominant) for various operational modes.

FIGURE 9.10

RELATIONSHIP BETWEEN INCIDENT AND REFLECTED SOUND WAVES

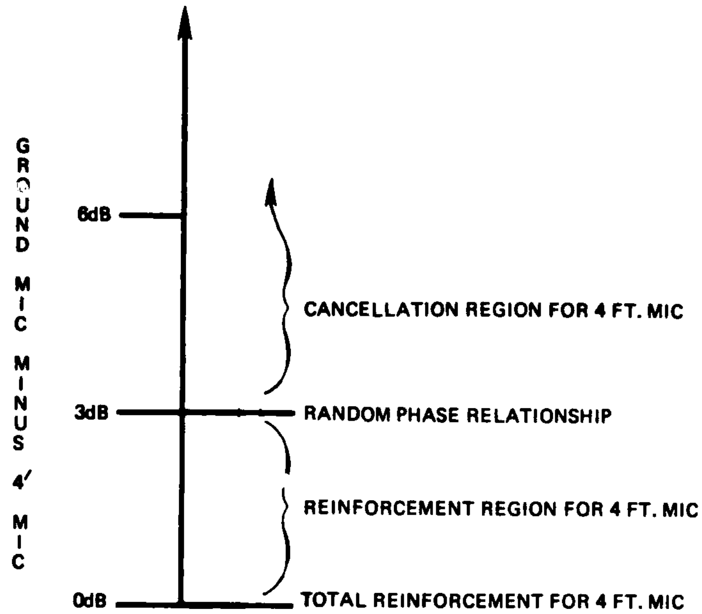


TABLE 9.3

HELICOPTER: TWINSTAR

COMPARISON OF

GROUND AND 4 FT. (1.2 M) MICROPHONE DATA

TEST SERIES	OPERATION	SAMPLE SIZE	TARGET IAS (KTS)	DELTA dB = (GND MIC.) minus (4 FT. MIC.) SEL	AL	EPNL	PNLTM
A	500' LFO	6	130.5	5	4.8	5.2	5
B	500' LFO	6	116	5.1	4.9	5.4	5
C	500' LFO	5	101.5	3.4	2.9	3.9	2.8
D	1000' LFO	7	130.5	3.8	3.8	4	5.7
E	ICAO T/O	8	63	2.9	3.4	3.1	2.6
F	ICAO APP	7	63	3.8	3.8	3.6	4.2
G	TAKEOFF	4	63	3.4	3.5	3.5	2.8
H	APPROACH	4	63	3.9	3.6	4	4.1
	WEIGHTED AVERAGE			3.9	3.95	4.07	4.08

9.4 Analysis of Duration Effects - This section consists of three parts, each developing relationships and insights useful in adjusting from one acoustical metric to another (typically from a maximum level to an energy dose). Each section quantitatively addresses the influence of the event duration.

9.4.1 Relationships Between SEL, AL and T_{10} - This analysis explores the relationship between the helicopter noise event (intensity) time-history, the maximum intensity, and the total acoustical energy of the event. Our interests in this endeavor include the following:

1) It is often necessary to estimate an acoustical metric given only part of the information required.

2) The time history duration is related to the ground speed and altitude of a helicopter. Thus any data adjustments for different altitudes and speeds will affect duration time and consequently the SEL (energy metric). The requirement to adjust data for these effects often arises in environmental impact analysis around heliports. In addition, the need to implement data corrections in helicopter noise certification tests further warrants the study of duration effects.

Two different approaches have been utilized in analyzing the effect of event 10-dB-down duration (DURATION or T_{10}) on the accumulated energy dose (Sound Exposure Level).

Both techniques are empirical, each employing the same input data but using a different theoretical approach to describe duration influences.

The fundamental question one may ask is "If we know the maximum A-weighted sound level and we know the 10-dB-down duration time, can we with confidence estimate the acoustical energy dose, the Sound Exposure Level?" A rephrasing of this question might be: If we know the SEL, the AL, and the 10-dB-down duration time (DURATION), can we construct a universal relationship linking all three?

Both attempts to establish relationships involve taking the difference between the SEL and AL (delta), placing the delta on the left side of the equation and solving as a function of duration. The form which this function takes represents the differences in approach.

In the first case, one assumes that delta equals some constant K(DUR) multiplied by the base 10 logarithm of DURATION, i.e.,

$$SEL - AL = K(DUR) \times LOG(DURATION)$$

In the second case, we retain the 10 x LOG dependency, consistent with theory, while achieving the equality through the shape factor, Q, which is some value less than unity i.e., SEL-AL = 10 x LOG(Q x DURATION). In a situation where the flyover noise event time history was represented by a step function or square wave shape, we would expect to see a value of Q

equaling precisely one. However, we know that the time history for typical non-impulsive event is much closer in shape to an isoceles triangle and consequently likely to have a Q much closer to 0.5.

Another possible use of this analytical approach for the assessment of duration effects is in correcting noise certification test data which were acquired under conditions of nonstandard ground speed and/or distance.

Discussion - Each of the noise template data tables lists both of the duration related figures of merit for each individual event (see Appendix B). One immediate observation is the apparent insensitivity of the metrics to changes in operation, and the extremely small variation in the range of metric values, nearly a constant Q = 0.4 and a stable K(A) value of 7.0. Data have been plotted in Figure 9.11 which show the minor variation of both metrics with airspeed for the level flyover operation for the microphone site 1 direct read system. The lack of variation in the parameters, suggests that a simple and nearly constant dependency exists between SEL, AL, and log DURATION, relatively unaffected by changes in airspeed, in turn suggesting a consistent time history shape for the range of airspeeds evaluated in this test. As SEL increases with airspeed, the increase appears to be related to increase in AL_M but mitigated in part by reduced duration time (and a nearly constant K(A)=7).

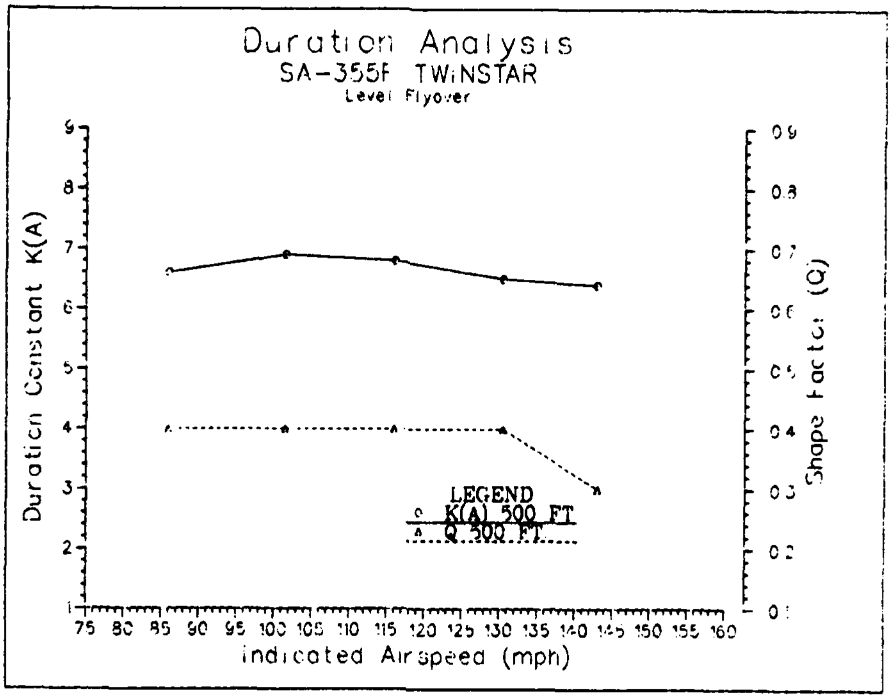


FIGURE 9.11

It is interesting to note that similar results were found for the Bell 222 helicopter, (Ref.10) suggesting that different helicopter models will have similar values for K and Q. This implies that it would not be necessary to develop unique constants for different helicopter models for use in implementing duration corrections. Caution is raised, however, to avoid any firm conclusion. The possibility exists that this particular analytical technique lacks the sensitivity necessary to detect distance and airspeed functionality.

9.4.2 Estimation of 10 dB Down Duration Time - In some cases, one does not have access to 10 dB down duratin time (DURATION) information. A moderate to highly reliable technique for estimating DURATION for the TwinStar is developed empirically in this section.

The distance from the helicopter to the observer at the closest point of approach (expressed in feet) divided by the airspeed (expressed in mph) yields a ratio, hereafter referred to as (D/V). This ratio has been compiled for various test series for micorphone sites 1,2 and 3 and has been presented in Table 9.4 along with the average DURATION expressed in seconds. A linear regression was performed on each data set in Table 9.4 and those results are also displayed in Table 9.4. Here one observes generally high correlation coefficients, in the range of 0.75 to 0.92. The regression equations relating DURATION with D/V are given as

Centerline center, Microphone Site 1:

$$T_{10} = [2.75 \times (D/V)] + 3.6$$

Sideline South, Microphone Site 2:

$$T_{10} = [2.15 \times (D/V)] + 7.3$$

Sideline North, Microphone Site 3:

$$T_{10} = [1.33 \times (D/V)] + 8.6$$

It is interesting to note that each relationship has a similar slope but the sideline site equations exhibit intercept values roughly 4 units (seconds) greater than the centerline site equation. This demonstrates that sideline sites generally experience flyover time histories which are longer and less peaked than the centerline site for a given distance and velocity. Because the regression analyses were conducted for a population consisting of all test series (which involved the operations in both directions) it is not possible to comment on left-right side acoustical directivity of the helicopter.

In summary, one sees that knowledge of the helicopter distance and velocity will enable an observer reasonably estimate the 10 dB down duration time.

TABLE 9.4

DURATION (T-10) REGRESSION ON D/V

HELICOPTER: TWINSTAR

SITE 1

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG DUR(A)	AVG EST ALT	D/V		
A	132.43	12.7	484.4	3.7	LINEAR	
B	114.71	15.2	513	4.5	REGRESSION	
C	132.8	16	484	3.6		
D	133.43	24.4	943.4	7.1	SITE #1	
E	61	29.7	602	9.9		
F	70.83	13.2	360.8	5.1	SLOPE	2.75
G	67.5	21.7	445.9	6.6	INTERCEPT	3.63
H	74.25	23	398.6	5.4	R SQ.	.83
M	141.8	11.3	485.1	3.4	R	.91
N	86	20.3	486.6	5.7	SAMPLE	10

SITE 2

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG DUR(A)	AVG EST ALT	D/V		
A	132.43	15.3	690.6	5.2	LINEAR	
B	114.71	19.9	711	6.2	REGRESSION	
C	132.8	22	690.4	5.2		
D	133.43	23.4	1064.1	8	SITE #2	
E	61	33.2	777.5	12.7		
F	70.83	27.6	610.1	8.6	SLOPE	2.15
G	67.5	25.9	664.2	9.8	INTERCEPT	7.29
H	74.25	32	633.2	8.5	R SQ.	.75
M	141.8	15.8	691	4.9	R	.87
N	86	23.3	692	8	SAMPLE	10

SITE 3

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG DUR(A)	AVG EST ALT	D/V		
A	132.43	15.4	690.8	5.2	LINEAR	
B	114.71	17.7	711.3	6.2	REGRESSION	
C	132.8	17.3	690.2	5.2		
D	133.43	22.9	1066	8	SITE #3	
E	61	26.6	757	12.4		
F	70.83	16.9	605.2	8.5	SLOPE	1.33
G	67.5	20.5	656.8	9.7	INTERCEPT	8.64
H	74.25	15.4	625.6	8.4	R SQ.	.61
M	141.8	13.7	690.6	4.9	R	.78
N	86	21.7	692	8	SAMPLE	10

Synthesis of Results - It is now possible to merge the results of Section 9.4.1 with the findings above in establishing a relationship linking (D/V) with SEL and AL. Given the approximation

$$SEL = AL + (10 \times LOG(0.45 \times DURATION))$$

it is possible to insert the computed value for $^{T}10$ (DURATION) into the equation and arrive at the desired relationship.

It is worth noting that the general trend observed for the TwinStar (longer sideline duration) is just opposite the trend observed for the Hughes 500D (Ref. 1). It appears necessary to carefully consider helicopter specific characteristics in estimating SEL or other energy-dose acoustical metrics at sideline locations. It is significant to note that slopes computed above for the TwinStar are very similar (approximately 2) to those observed for the Hughes 500D, suggesting that a general relationship would do well in assessing changes or differentials in noise level with changes in either distance or velocity.

9.4.3 Relationship Between SEL minus AL and the Ratio D/V - The difference between SEL and AL_M or conversely, EPNL and $PNLT_M$ (in a certification context), is referred to as the DURATION CORRECTION. This difference is clearly controlled by the event $^{T}10$ or (10 dB down duration time) and the acoustical energy contained within those bounds. As discussed in previous sections, the $^{T}10$ is highly correlated with the ratio D/V. This analysis establishes a direct link between D/V and the DURATION CORRECTION in a manner similar to that employed in Section 9.4.2.

Table 9.5 provides a summary of data used in regression analyses for microphones 1, 2 and 3. The regression equations along with other statistical information is also provided in Table 9.5.

It is encouraging to note the strong correlations (coefficients greater than 0.85) which suggest that SEL can be estimated directly (and with confidence) from the AL_M and knowledge of D/V. It is also interesting to note that similar regression equations. As mentioned in Section 9.4.2, it is difficult to comment explicitly (and quantitatively) on source directivity because operations were conducted in both directions. Regardless, one can see that centerline/sideline differences exist. The reader is cautioned not to expect these relationships to necessarily hold for D/V ratios beyond the range explored in these anaylses.

TABLE 9.5

SEL-ALm REGRESSION ON D/V

HELICOPTER: TWINSTAR

SITE 1

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG SEL-ALm	AVG EST ALT	D/V
A	132.43	7.1	484.4	3.7
B	114.71	7.8	513	4.5
C	132.8	7.9	484	3.6
D	133.43	9.4	943.4	7.1
E	61	10.4	602	9.9
F	70.83	7.4	360.8	5.1
G	67.5	9	445.9	6.6
H	74.25	8.7	398.6	5.4
M	141.8	6.3	485.1	3.4
N	86	8.6	486.6	5.7

LINEAR REGRESSION

SITE #1

SLOPE	.56
INTERCEPT	5.21
R SQ.	.84
R	.92
SAMPLE	10

SITE 2

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG SEL-ALm	AVG EST ALT	D/V
A	132.43	8.1	690.6	5.2
B	114.71	8.8	711	6.2
C	132.8	9.2	690.4	5.2
D	133.43	9.6	1064.1	8
E	61	11.3	777.5	12.7
F	70.83	10.5	610.1	8.6
G	67.5	10.4	664.2	9.8
H	74.25	11.4	633.2	8.5
M	141.8	7.8	691	4.9
N	86	9.6	692	8

LINEAR REGRESSION

SITE #2

SLOPE	.44
INTERCEPT	6.3
R SQ.	.74
R	.86
SAMPLE	10

SITE 3

TEST SERIES	COCKPIT PHOTO DATA V AVG	AVG SEL-ALm	AVG EST ALT	D/V
A	132.43	8.1	690.8	5.2
B	114.71	8.9	711.3	6.2
C	132.8	8.7	690.2	5.2
D	133.43	9.5	1066	8
E	61	10.3	757	12.4
F	70.83	8.5	605.2	8.5
G	67.5	9.5	656.8	9.7
H	74.25	8.1	625.6	8.4
M	141.8	7.7	690.6	4.9
N	86	9.5	692	8

LINEAR REGRESSION

SITE #3

SLOPE	.26
INTERCEPT	6.87
R SQ.	.58
R	.76
SAMPLE	10

9.5 <u>Analysis of Variability in Noise Levels for Two Sites Over Similiar Propagation Paths</u> - This analysis examines the differences in noise levels observed for two sites each located 500 feet away from the hover point over similar terrain. The objective of the analysis was to examine variability in noise levels associated with ground-to-ground propagation over nominally similar propagation paths. The key word in the last sentence was nominally,...in fact the only difference in the propagation paths is that microphone 1H was located in a slight depression, (elevation is minus 2.5 feet relative to the hover point), while site 2 has an elevation of plus 0.2 feet relative to the hover point. This is a net difference of 2.7 feet over a distance of 500 feet. This configuration serves to demonstrate the sensitivity of ground-to-ground sound propagation to minor terrain variations.

<u>Discussion</u> - The results presented in Table 9.6, 9.7, and 9.8 show the observed differences in time average noise levels for eight directivity angles and the spacial average. In each case, magnetic recording data (Appendix C) have been used in the analyses. It is observed that significant differences in noise level occur for the low angle (ground-to-ground) propagation scenarios.

It is speculated that very minor variations in site elevation (and resulting microphone placement) lead to site-to-site differences in the measured noise levels for static operations. Differences in microphone height result in different positions within the interference pattern of incident and reflected sound waves. It is also appropriate to consider

whether variation in the acoustical source characteristics contributes to noise level differences. In this analysis, magnetic recording data from microphone site 2 are compared with data recorded at site 1H approximately one minute later. That is, the helicopter rotated 45 degrees every sixty seconds, in order to project each directivity angle (there is a 45 degree separation between the two sites). In addition to source variation, it is also possible that the helicopter "aim," based on magnetic compass readings may have been slightly different in each case, resulting in the projection of different intensities and accounting for the observed differences. A final item of consideration is the possibility of refraction of sound waves (due to thermal or wind gradients) resulting in shadow regions. It is worth noting that, generally, similar results have been observed for other test helicopters (Bell 222, ref. 10; Aerospatiale Dauphin, ref. 11).

Regardless of what the mechanisms are which create this variance, one perceives that static operations display intrinsically variant sound levels, in both direction and time, and also potentially variant (all other factors being normalized) for two nominally identical propagation paths.

TABLE 9.6

COMPARISON OF
NOISE VERSUS DIRECTIVITY ANGLES
FOR
TWO SOFT SURFACES

HELICOPTER: TWINSTAR

OPERATION: HOVER-IN-GROUND

	DIRECTIVITY ANGLES (DEGREES)								Lav(360 DEGREE)	
SITE	0	45	90	135	180	225	270	315	ENERGY	ARITH.
	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ
SOFT 1H	62	66.5	61.2	64.8	67.3	66.6	68.1	67.2	66	65.5
SOFT 2	67	72.2	70.4	73.4	75.9	74.6	73.3	69.8	72.8	72.1
DELTA dB	5	5.7	9.2	8.6	8.6	8	5.2	2.6	6.8	6.6

* DELTA dB = (SITE 1H) minus (SITE 2)

TABLE 9.7

COMPARISON OF
NOISE VERSUS DIRECTIVITY ANGLES
FOR
TWO SOFT SURFACES

HELICOPTER: TWINSTAR

OPERATION: HOVER-OUT-OF-GROUND

	DIRECTIVITY ANGLES (DEGREES)								Lav(360 DEGREE)	
SITE	0	45	90	135	180	225	270	315	ENERGY	ARITH.
	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ
SOFT 1H	66.5	72.5	68.3	74	78.4	79.2	71.1	66.9	74.5	72.1
SOFT 2	72.3	76.2	75.1	79.6	83	79.2	74.8	75.3	78.2	76.9
DELTA dB	5.8	3.7	6.8	5.6	4.6	0	3.7	8.4	3.7	4.8

* DELTA dB = (SITE 1H) minus (SITE 2)

TABLE 9.8

COMPARISON OF
NOISE VERSUS DIRECTIVITY ANGLES
FOR
TWO SOFT SURFACES

HELICOPTER: TWINSTAR

OPERATION: FLIGHT IDLE

	DIRECTIVITY ANGLES (DEGREES)								Lav(360 DEGREE)	
SITE	0	45	90	135	180	225	270	315	ENERGY	ARITH.
	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ	LEQ
SOFT 1H	56.6	57.8	60.2	62.1	60.8	62.8	61.2	59.9	60.6	60.2
SOFT 2	65	69.3	70	73.4	68.6	72.5	71.5	67	70.4	69.7
DELTA dB	8.4	11.5	9.8	11.3	7.8	9.7	10.3	7.1	9.8	9.5

* DELTA dB = (SITE 1H) minus (SITE 2)

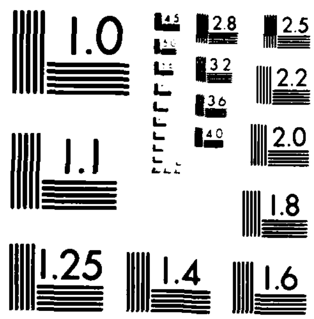
9.6 Variation in Noise Levels With Airspeed for 6 and 9 Degree Approach Operations - This section examines the variation in noise level for variations in approach angle. This analysis has two objectives: first, to evaluate further the realm of "Fly Neighborly" operating possibilities, and second, to consider whether or not it is reasonable to consider establishing a range of approach operating conditions for noise certification testing. The appropriate "as measured" acoustical data, contained in Appendix A, have been tabulated in Table 9.9 and plotted (corrected for the minor differences in altitude) in Figures 9.12 - 9.13.

Discussion - In the approach operational mode, impulsive (banging or slapping) acoustical signatures are a result of the interaction between vortices (generated by the fundamental rotor blade action) colliding with successive sweeps of the rotor blades (see Figure 9.14). As reported in reference 11, for certain helicopters, maximum interaction occurs at airspeeds in the 50 to 70 knot range, at rates-of-descent ranging from 200 to 400 feet per minute. When the rotor blade enters the vortex region, it experiences local pressure fluctuations and associated changes in blade loading. These perturbations and resulting pressure gradients generate the characteristic impulsive signature.

The data presented in Figures 9.12 and 9.13 portray the variation in noise level along the ground track for centerline noise sites as the approach angle (rate of descent) changes from 6 to 9 degrees) with airspeed held nominally constant. The 9 degree approach achieves a 2 dB reduction in the intensity metric L_A at each measurement site. The reduction in the energy metric SEL varies from 0 to 2 dB from site 4 to site 5.

AD-A147 497 NOISE MEASUREMENT FLIGHT TEST: DATA/ANALYSES AEROSPATIALE AS 355F TWINSTA..(U) FEDERAL AVIATION ADMINISTRATION WASHINGTON DC OFFICE OF ENVIR.. 2/3

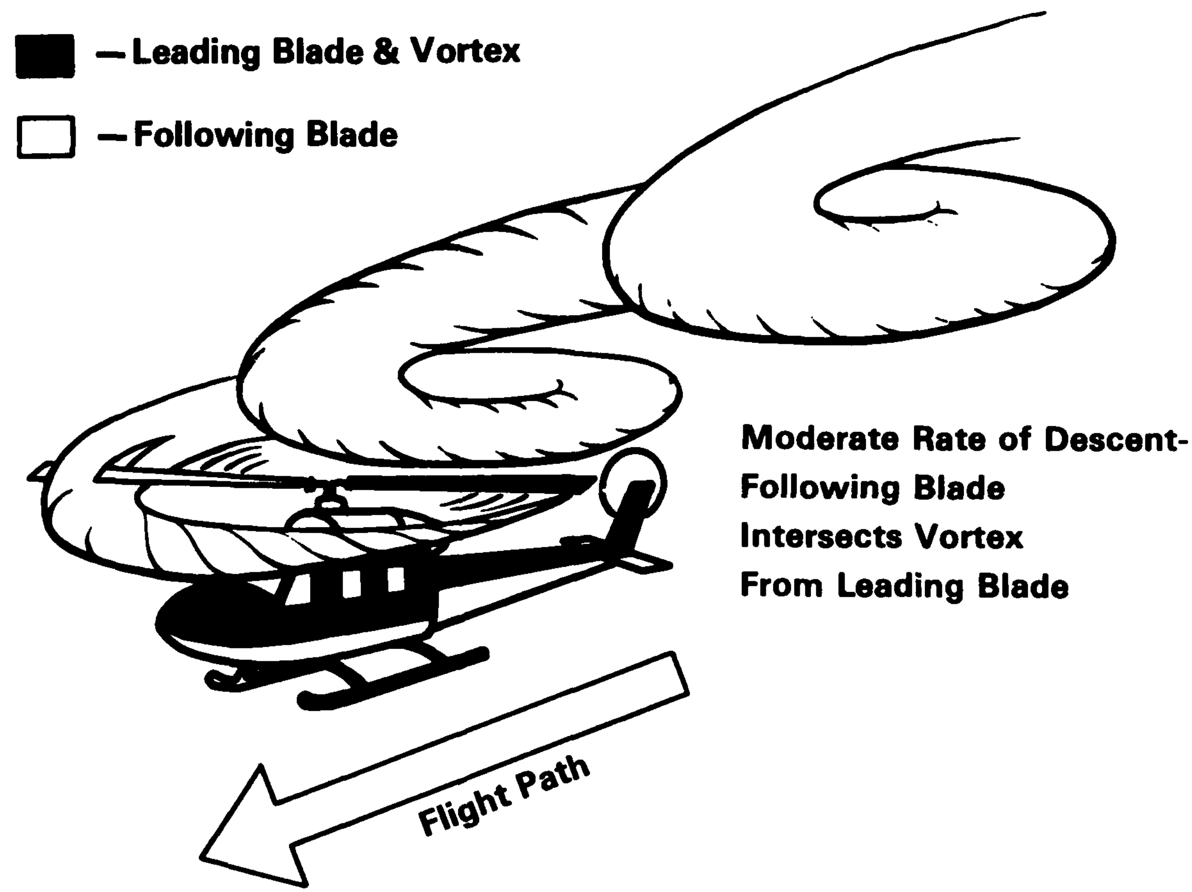
UNCLASSIFIED J S NEWMAN ET AL. AUG 84 DOT/FAA/EE-84-04 F/G 20/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FIGURE 9.14

Tip Vortex Interaction



It is believed that the descent changes the vertical location of the trip vortices with respect to the blades, thereby changing the relative degree of interaction. From a certification standpoint, it is clear that the 6 degree approach would present a greater noise exposure than the alternative procedure examined.

It is noted that a more exhaustive series of testing would include 5 to 6 airspeeds (and additional microphone locations) for each approach angle. A recent study conducted in France (ref. 14) included a matrix of 24 microphones. While cost and logistical constraints make this unrealistic for evaluation of each civil transport helicopter, one would be prudent to evaluate several centerline and sideline microphone locations for a variety of operational modes in any in-depth "Fly Neighborly" flight test program.

Two other points of concern in developing "Fly Neighborly" procedures are safety and passenger comfort. Rates of descent, airspeed, initial approach altitude and "engine-out" performance are all factors requiring careful consideration in establishing a noise abatement approach. Finally, while certain operational modes may significantly reduce noise levels, there may be an unacceptable acceleration /deceleration or rate-of-descent imposed on passengers. This clearly presents an important trade-off to consider in any commercial air-shuttle operation.

Table 9.9

	Average AL	Average SEL
6^{o}	83.9	91.3
9^{o}	80.9	89.6
9^{o} adjusted	81.8	90.2

The 9 degree metrics were adjusted for differences in altitude between the 6 and 9 degree approach operations.

TWINSTAR APPROACH OPERATION PLOTS

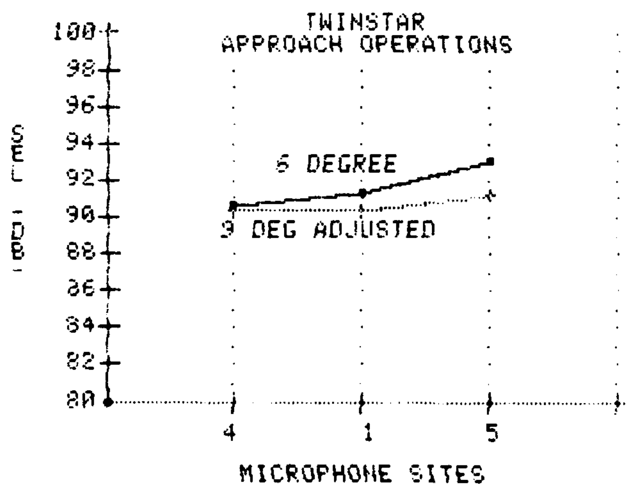


FIGURE 9.12

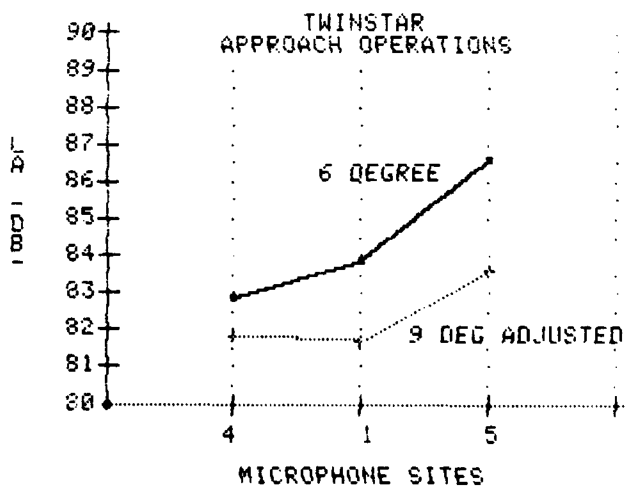


FIGURE 9.13

9.7 Analysis of Ground-to-Ground Acoustical Propagation

9.7.1 Soft Propagation Path - This analysis involves the empirical derivation of propagation constants for a nominally level, "soft" path, a ground surface composed of mixed grasses. As discussed in previous analyses, there are several physical phenomena that influence the diminution of sound over distance. Among these phenomena, spreading loss, ground-to-ground attenuation and refraction are considered dominant in controlling the observed propagation constants.

A-weighted L_{eq} data for the four static operational modes- HIGE, HOGE, Flight Idle, and Ground Idle- have been analyzed in each case for eight different directivity angles. Direct read acoustical data from sites 2 and 4H have been used to calculate the propagation constants (K) as follows:

$$K = (Leq(\text{site } 2) - Leq(\text{site } 4))/\text{Log } (2/1)$$

where the Log (2/1) factor represents the doubling of distance dependency (Site 2 is 492 feet and site 4H is 984 feet from the hover point).

For each mode of operation, the average (over various directivity angles) propagation constant has also been computed.

The data used in this analysis (derived from Appendix C) are displayed in Table 9.10 and the results are summarized in Table 9.11.

Discussion - The results shown in Table 9.13 exhibit some minor variation from one operational mode to the next. For the higher elevation angle operation (HOGE), one observes a smaller rate of attenuation. In the case of HIGE and Flight Idle (FI), one observes similar and rather consistent attenuation constants, 37 and 35 respectively. The attenuation constants tend to differ from results reported for the Hughes 500D (ref. 10) and the Aerospatiale Dauphin (ref. 9). As noted in those reports, the relationship dB = 25 log (d1/d2) provided a reasonable working approximation for calculating ground-to-ground diminution of A-weighted sound levels over nominally soft paths out to a distance of 1000 feet.

In the case of the TwinStar however, it appears that a relationship of the form ΔdB = 35 log (d1/d2) would perform better.

9.7.2 Hard Propagation Path - This part of the analyses involves the empirical derivation of constants for sound propagation over a "hard" propagation path, a concrete/composite taxi-way surface. The analytical methods described above (Section 9.7.1) are applicable using data from sites 5H and 7H, respectively 492 and 717 feet from the hover site. The data used in this analyses (derived from Appendix D) are shown in Table 9.13 and the results are summarized in Table 9.13. The salient feature of this scenario is the presence of a ground surface which is highly reflective and uniform in composition.

Discussion - The results shown in Table 9.1 exhibit significant mode to mode variation. The results for HOGE are somewhat anomolous, perhaps controlled by refraction effects. At the time of the static test, there was very little wind, a minor temperature inversion and very high humidity. In spite of certain anomolous results, it is clear that sound propagates more efficiently over a hard path. Calculations produce a mean propagation constant of 20 (setting aside the HOGE results) as opposed to 35 for the soft path. In conducting environmental impact analyses involving hard paths between heliports and noise sensitive areas, it appears reasonable to use an approximate propagation costant of 20 in analyzing propagation out to distances of 1000 feet.

TABLE 9.10

DATA UTILIZED IN COMPUTING EMPIRICAL

PROPAGATION CONSTANTS (K)

FOR SOFT SITES (4H + 2)

TWINSTAR

6-7-93

SITE 4H (SOFT SITE)

HIGE	LEQ	FLT.IDLE	LEQ	GRN.IDLE		HOGE	LEQ
I-0	58.40	J-0A	55.30	J-0B	44.40	K-0	64.70
I-315	60.40	J-315A	57.80	J-315B	NA	K-315	65.50
I-270	63.60	J-270A	61.50	J-270B	48.70	K-270	65.60
I-225	64.10	J-225A	60.80	J-225B	NA	K-225	69.60
I-180	63.60	J-180A	59.20	J-180B	49.40	K-180	74.60
I-135	60.80	J-135A	62.70	J-135B	NA	K-135	75.40
I-90	58.80	J-90A	59.10	J-90B	49.40	K-90	67.30
I-45	61.60	J-45A	59.20	J-45B	NA	K-45	64.70

SITE 2 (SOFT SITE)

HIGE	LEQ	FLT.IDLE	LEQ	GND.IDLE	LEQ	HOGE	LEQ
I-0	67.90	J-0A	65.40	J-0B	54.50	K-0	72.80
I-315	70.70	J-315A	67.80	J-315B	NA	K-315	75.30
I-270	73.80	J-270A	72.10	J-270B	58.50	K-270	75.50
I-225	75.20	J-225A	72.40	J-225A	NA	K-225	79.70
I-180	76.20	J-180A	69.00	J-180B	NA	K-180	83.50
I-135	73.00	J-135A	73.60	J-135B	NA	K-135	80.20
I-90	70.90	J-90A	69.70	J-90B	58.90	K-90	75.90
I-45	72.60	J-45A	NA	J-45B	NA	K-45	77.10

TABLE 9.11

EMPIRICAL PROPOGATION CONSTANTS (K)
FOR SOFT SITES (4H+2)

EMISSION ANGLE	HIGE K	FLT.IDLE K	GND.IDLE K	HOGE K
0	31.67	33.67	33.67	27.00
315	34.33	33.33		32.67
270	34.00	35.33	32.67	33.00
225	37.00	38.67		33.67
180	42.00	32.67		29.67
135	40.67	36.33		16.00
90	40.33	35.33	31.67	28.67
45	36.67			41.33
AVERAGE	37.08	35.05	32.67	32.29**

** AVERAGE WITHOUT 135 DEGREE

TABLE 9.12

DATA UTILIZED IN COMPUTING EMPIRICAL

PROPAGATION CONSTANTS (K)

FOR HARD SITES (5H + 7H)

TWINSTAR

6-7-83

SITE 5H (HARD SITE)

HIGE	LEQ	FLT.IDLE	LEQ	GRN.IDLE	LEQ	HOGE	LEQ
I-90	72.60	J-90A	75.60	J-90B	65.40	K-90	78.30
I-45	76.40	J-45A	75.00	J-45B	NA	K-45	79.40
I-0	74.00	J-0A	70.30	J-0B	65.90	K-0	72.20
I-315	77.30	J-315A	76.50	J-315B	NA	K-315	76.00
I-270	81.50	J-270A	83.00	J-270B	64.60	K-270	77.70
I-225	84.90	J-225A	78.80	J-225B	NA	K-225	86.10
I-180	85.30	J-180A	74.90	J-180B	62.00	K-180	81.90
I-135	79.90	J-135A	77.40	J-135B	NA	K-135	NA

SITE 7H (HARD SITE)

HIGE	LEQ	FLT.IDLE	LEQ	GND.IDLE	LEQ	HOGE	LEQ
I-90	67.23	J-90A	69.85	J-90B	58.66	K-90	75.05
I-45	71.23	J-45A	68.02	J-45B	NA	K-45	77.06
I-0	69.89	J-0A	63.58	J-0B	55.49	K-0	68.67
I-315	73.11	J-315A	71.68	J-315B	NA	K-315	72.65
I-270	78.68	J-270A	77.38	J-270B	57.64	K-270	75.33
I-225	80.62	J-225A	73.59	J-225B	NA	K-225	83.14
I-180	79.87	J-180A	67.73	J-180B	55.85	K-180	78.84
I-135	73.98	J-135A	71.15	J-135B	NA	K-135	76.34

TABLE 9.13

EMPIRICAL PROPOGATION CONSTANTS (K)
FOR HARD SITES (5H+7H)

EMISSION ANGLE	HIGE K	FLT.IDLE K	GND.IDLE K	HOGE K
90	17.90	19.17	22.47	10.83
45	17.23	23.27		7.80
0	13.70	22.40	34.70	11.77
315	13.97	16.07		11.17
270	9.40	18.73	23.20	7.90
225	14.27	17.37		9.87
180	18.10	23.90	20.50	10.20
135	19.73	20.83		
AVERAGE	15.54	20.22	25.22	9.93
	16.41**			

** AVERAGE WITHOUT 270 DEGREE ANGLE

9.8 Air-to-Ground Acoustical Propagation Analysis - The approach and takeoff operations provided the opportunity to assess empirically the influences of spherical spreading and atmospheric absorption. Through utilization of both noise and position data at each of the three flight track centerline locations (microphones 5, 1, and 4), it was possible to determine air-to-ground propagation constants.

One would expect the propagation constants to reflect the aggregate influences of spherical spreading and atmospheric absorption. It is assumed that the acoustical source characteristics remain constant as the helicopter passes over the measurement array. In past studies (Ref. 10, Ref. 11, Ref. 12), it has been observed that this assumption is reasonably valid for takeoff and level flyover operations. In the case of approach, however, significant variation has been evident. Because of the spacial/temporal variability in approach sound radiation along the (1000 feet) segment of interest, approach data have not been utilized in estimating propagation constants. As a final background note relating to the assumption of source stability, a helicopter would require approximately 10 seconds, travelling at 60 knots, to travel the distance between measurement sites 4 and 5.

In both the case of the single event intensity metric, AL, and the single event energy metric, SEL, the difference between SEL and AL is determined for each pair of centerline sites. The delta in each case is then equated with the base ten logarithm of the respective altitude ratio multiplied by the propagation constant (either KA(AL) or KA(SEL), the values to be determined.

Data have also been analyzed from the 500 and 1000 foot level flyover operations and the KA(AL) has been computed. In this case data were pooled for all centerline sites (5, 1, and 4) in the process of arriving at the propagation constant.

The takeoff analyses are shown in Table 9.14 and 9.15 and are summarized in Table 9.16. Results of the level flyover calculations are presented in Table 9.18. The level flyover and takeoff analyses are also accompanied by a tabulation of results from three previous reports (Tables 9.18 and 9.19).

<u>Discussion</u> - In the case of takeoff data (Table 9.16) one observes a propagation constant of 24.5 (the midway point for two highly variant results, 20 and 30). This variation suggests that the source frequency content plays a significant role in influencing rate of attenuation.

In the case of level flyover data (Table 9.18), one observes a value of approximately 20, somewhat lower than the results found for the Dauphin and the Huges 500 D. A comparison to the Bell 222 (ref. 10), however, does not fare so well (Bell 222, KA(AL) = 27.8). This difference is likely associated with disparate source frequency content and different absoprtion characteristics on the various test days.

Table 9.20 provides a brief examination of propagation constants for the EPNL acoustical metric, used in noise certification. Calculations show a constant of approximately 13. This constant is in contrast to results for other helicopters summarized in Table 9.21. The reader may consider computing propagation constants for other acoustical metrics as the need arises.

TABLE 9.14

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: ICAO TAKEOFF
TARGET IAS=63 MPH

MIC. 5-4

EVENT NO.	KP(AL)	KP(SEL)
E26	18.8	10.9
E27	15	11.4
E28	18.8	10.1
E29	20	12.1
E30	20.9	12.4
E31	21	12.9
E32	21.5	12
E33	20.2	12.8
AVERAGE	19.5	11.8
STD. DEV	2.10	0.98
90% C.I.	1.41	0.65

TABLE 9.15

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: STANDARD TAKEOFF
TARGET IAS=63 MPH

MIC. 5-4

EVENT NO.	KP(AL)	KP(SEL)
G38	28.8	17.6
G39	36.5	18.7
G40	27.2	15.2
G41	24.8	12.4
AVERAGE	29.3	16
STD. DEV	5.04	2.78
90% C.I.	5.93	3.27

TABLE 9.16

Summary Table of Propagation Constants for Two Takeoff Operations

ICAO Takeoff	19.5
Standard Takeoff	29.3
Average	24.4

TABLE 9.17

Summary Table for Takeoff Operation AL Metric

Helicopter	Propagation Constant (k)
Bell 222	N/A
Aerospatiale Dauphin 2	20.06
Hughes 500D	21.15
Aerospatiale TwinStar	24.4
Average	22.07

TABLE 9.18

TWINSTAR

LEVEL FLYOVER PROPAGATION--AL

OPERATION		MIC 5	MIC 1	MIC [illegible]	AL WEIGHTED AVERAGE
	N=	6	6	6	
500' (0.9Vh)	AVG AL=	77.7	77.8	77.3	77.60
	STD DEV=	.6	.9	.9	
	N=	7	7	7	
1000' (0.9Vh)	AVG AL=	72.4	71.5	71.5	71.80
	STD DEV=	.9	.3	1	

K= △dB / LOG(945.72 / 488.15) △dB= 5.80

K= 5.80 / .2872093

K= 20.19

TABLE 9.19

SUMMARY FOR LEVEL FLYOVER OPERATION

AL METRIC

HELICOPTER	PROPAGATION CONSTANT (K)
BELL 222	21.08
AEROSPATIALE DAUPHIN 2	21.40
HUGHES 500D	20.81
AEROSPATIALE TWINSTAR	20.19

AVERAGE = 20.87

TABLE 9.20

TWINSTAR

LEVEL FLYOVER PROPAGATION--EPNL

OPERATION		MIC 5	MIC 1	MIC 4	EPNL WEIGHTED AVERAGE
	N=	6	6	6	
500' (0.9Vh)	AVG EPNL=	88.8	88.7	88.4	88.63
	STD DEV=	.4	.7	.6	
	N=	7	5	7	
1000' (0.9Vh)	AVG EPNL=	85.1	84.4	84.4	84.66
	STD DEV=	.6	.6	.6	

K= ΔdB / LOG(945.72 / 488.15) ΔdB= 3.98

K= 3.98 / .2872093

K= 13.84

TABLE 9.21

SUMMARY TABLE FOR EPNL

HELICOPTER	PROPAGATION CONSTANT (K)
BELL 222	14.33
AEROSPATIALE DAUPHIN 2	18.67
HUGHES 500D	14.80
AEROSPATIALE TWINSTAR	13.84

AVERAGE = 15.41

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4. "Measuring Micro-Wind Structure in the Vicinity of the Microphone Array During Noise Certification Testing," ICAO Committee on Aviation Enviroinmental Protection, Working Group II Meeting, Boston, MA, May 1984.

5. "Noise Standards: Aircraft Type and Airworthiness Certification," Federal Aviation Regulations Part 36, Department of Transportation, Washington, D.C., June 1974.

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APPENDIX A

Magnetic Recording Acoustical Data and Duration Factors for Flight Operations

This appendix contains magnetic recording acoustical data acquired during flight operations. A detailed discussion is provided in Section 6.0 which describes the data reduction and processing procedures. Helpful cross references include measurement location layout, Figure 3.3; measurement equipment schematic, Figure 5.4; and measurement deployment plan, Figure 5.7. Tables A.a and A.b which follow below provide the reader with a guide to the structure of the appendix and the definition of terms used herein.

TABLE A.a

The key to the table numbering system is as follows:

Table No. A. 1-1. 1

Appendix No. (A.)

Helicopter No. & Microphone Location (1-1.)

Page No. of Group (1)

Microphone No.	1	centerline-center
	1G	centerline-center(flush)
	2	sideline 492 feet (150m) south
	3	sideline 492 feet (150m) north
	4	centerline 492 feet (150m) west
	5	centerline 617 feet (188m) east

TABLE A.b

Definitions

A brief synopsis of Appendix A data column headings is presented.

EV	Event Number
SEL	Sound Exposure Level, the total sound energy measured within the period determined by the 10 dB down duration of the A-weighted time history. Reference duration, 1-second.
ALm	A-weighted Sound Level(maximum)
SEL-ALm	Duration Correction Factor
K(A)	A-weighted duration constant where:
	K(A) = (SEL-ALm) / (Log DUR(A))
Q	Time History Shape Factor, where:
	$Q = (10^{0.1(SEL-ALm)} / (DUR(A))$
EPNL	Effective Perceived Noise Level
PNLm	Perceived Noise Level(maximum)
PNLTm	Tone Corrected Perceived Noise Level(maximum)
K(P)	Constant used to obtain the Duration Correction for EPNL, where:
	K(P) = (EPNL-PNLTm + 10) / (Log DUR(P))
OASPLm	Overall Sound Pressure Level(maximum)
DUR(A)	The 10 dB down Duration Time for the A-weighted time history
DUR(P)	The 10 dB down Duration Time for the PNLT time history
TC	Tone Correction calculated at PNLTm

Each set of data is headed by the site number, microphone location and test date. The target reference condtions are specified above each data subset.

TABLE NO. A.2-1.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1 CENTERLINE - CENTER JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	84.4	77.3	7.1	6.5	0.4	88.2	89.6	91.4	6.6	86.9	12.5	11.0	1.8
A2	85.4	78.3	7.1	6.2	0.4	89.4	90.6	92.1	6.5	88.7	14.0	13.0	1.5
A3	84.8	78.7	6.1	6.3	0.4	88.8	90.9	92.4	6.7	88.3	9.5	9.0	1.7
A4	85.4	78.0	7.4	6.6	0.4	89.3	90.2	91.9	6.7	88.7	13.0	12.5	1.8
A5	84.1	76.2	7.9	6.9	0.4	87.7	89.2	91.1	6.5	87.5	14.0	10.5	1.8
A6	84.9	78.1	6.9	6.3	0.4	89.0	90.3	92.1	6.5	87.9	12.5	11.5	1.8
Avg.	84.8	77.8	7.1	6.5	0.4	88.7	90.1	91.8	6.6	88.0	12.6	11.2	1.7
Std Dv	0.5	0.9	0.6	0.3	0.0	0.7	0.6	0.5	0.1	0.7	1.7	1.4	0.1
90% CI	0.4	0.7	0.5	0.2	0.0	0.5	0.5	0.4	0.1	0.6	1.4	1.2	0.1
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	83.8	75.9	7.9	6.7	0.4	87.4	88.4	89.8	6.8	84.1	15.0	13.5	1.5
B9	83.2	75.7	7.5	6.8	0.4	86.7	88.7	90.2	6.5	83.9	12.5	10.0	1.5
B10	83.2	75.2	8.0	6.8	0.4	86.9	87.7	89.2	6.6	83.5	15.0	14.5	1.4
B11	83.0	75.5	7.5	6.7	0.4	86.6	87.9	89.2	6.7	83.4	13.5	12.5	1.3
B12	83.6	75.0	8.5	6.7	0.4	87.1	87.6	88.8	6.7	83.5	18.5	17.5	1.3
B13	82.6	75.1	7.5	6.6	0.4	86.4	87.4	88.8	6.9	83.1	13.5	12.5	1.3
Avg.	83.2	75.4	7.8	6.7	0.4	86.9	87.9	89.3	6.7	83.6	14.7	13.4	1.4
Std Dv	0.4	0.4	0.4	0.1	0.0	0.4	0.5	0.6	0.1	0.4	2.1	2.5	0.1
90% CI	0.3	0.3	0.3	0.1	0.0	0.3	0.4	0.5	0.1	0.3	1.7	2.1	0.1
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	82.7	75.1	7.6	6.4	0.4	86.2	87.5	88.8	6.4	82.8	15.0	14.0	1.3
C15	83.7	75.7	8.1	6.8	0.4	87.1	88.3	89.6	6.7	83.9	15.0	13.0	1.3
C16	83.5	76.3	7.2	6.1	0.4	87.0	88.8	90.1	6.4	84.5	15.0	12.5	1.4
C17	83.7	75.2	8.5	6.8	0.4	87.1	88.0	89.3	6.7	84.0	17.5	14.5	1.3
C18	83.6	75.4	8.2	6.7	0.4	87.0	88.0	89.4	6.4	83.6	17.0	15.5	1.4
Avg.	83.4	75.5	7.9	6.6	0.4	86.9	88.1	89.4	6.5	83.8	15.9	13.9	1.4
Std Dv	0.4	0.5	0.5	0.3	0.0	0.4	0.5	0.5	0.2	0.6	1.2	1.2	0.1
90% CI	0.4	0.5	0.5	0.3	0.0	0.4	0.5	0.4	0.2	0.6	1.2	1.1	0.1

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-1.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1 CENTERLINE - CENTER JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER -- TARGET IAS 130.5 MPH													
D19	81.4	71.8	9.5	6.8	0.4	84.9	84.1	85.9	6.7	82.7	25.5	21.0	1.9
D20	81.3	71.6	9.7	6.9	0.4	-	84.0	86.0	-	82.8	25.0	-	2.1
D21	81.5	71.6	9.9	6.7	0.3	85.0	83.6	85.7	6.4	81.4	29.5	28.5	2.0
D22	80.2	71.3	8.8	6.6	0.3	83.6	83.4	85.3	6.3	81.8	22.0	20.5	1.9
D23	80.8	71.3	9.5	6.9	0.4	-	83.1	85.1	-	81.1	24.0	-	1.9
D24	80.8	72.0	8.8	7.1	0.4	84.4	84.1	86.2	6.7	82.5	17.5	16.5	2.1
D25	80.8	71.1	9.6	6.7	0.3	84.0	83.0	84.6	6.9	81.2	27.0	24.0	1.6
Avg.	81.0	71.5	9.4	6.8	0.4	84.4	83.6	85.5	6.6	81.9	24.4	22.1	1.9
Std Dv	0.5	0.3	0.4	0.2	0.0	0.6	0.5	0.6	0.2	0.7	3.8	4.5	0.2
90% CI	0.3	0.2	0.3	0.1	0.0	0.6	0.3	0.4	0.2	0.5	2.8	4.3	0.1
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	83.8	73.6	10.2	6.9	0.3	86.9	86.2	87.9	6.8	80.2	30.5	21.0	1.7
E27	83.5	73.2	10.4	6.9	0.3	86.7	84.7	86.9	6.7	79.4	32.5	28.5	2.2
E28	84.7	74.4	10.4	7.2	0.4	88.1	86.5	88.3	7.0	80.4	27.5	25.5	1.8
E29	83.5	74.0	9.5	7.1	0.4	86.8	86.0	87.9	6.9	79.9	22.0	19.5	2.1
E30	83.0	71.1	11.9	7.8	0.5	86.5	84.4	86.3	7.0	79.3	34.5	29.0	2.0
E31	83.2	73.5	9.8	7.2	0.4	86.8	85.2	87.0	7.1	79.7	22.5	24.0	2.1
E32	83.9	73.3	10.6	7.4	0.4	87.2	85.1	86.7	7.3	78.9	27.0	27.5	1.6
E33	84.6	73.9	10.7	6.6	0.3	87.6	86.1	88.0	7.3	79.7	41.0	21.0	1.9
Avg.	83.8	73.4	10.4	7.1	0.4	87.1	85.5	87.4	7.0	79.7	29.7	24.5	1.9
Std Dv	0.6	1.0	0.7	0.3	0.1	0.5	0.8	0.7	0.2	0.5	6.4	3.7	0.2
90% CI	0.4	0.7	0.5	0.2	0.0	0.4	0.5	0.5	0.1	0.3	4.3	2.5	0.1
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42	91.1	83.1	8.0	7.3	0.5	93.6	94.8	95.9	7.1	91.0	12.5	12.0	1.1
F43	92.0	84.1	7.9	7.1	0.5	95.0	95.9	97.0	7.2	91.5	13.0	13.0	1.5
F44	91.0	84.6	6.4	6.2	0.4	94.1	96.9	98.1	6.0	92.8	11.0	10.0	1.2
F45	91.5	83.8	7.7	7.0	0.5	94.8	96.2	97.3	6.8	92.9	12.5	12.5	1.2
F46	91.7	84.7	7.0	6.3	0.4	94.7	96.3	97.1	6.8	92.1	13.0	13.0	0.7
F47	91.0	82.8	8.2	6.3	0.3	93.6	94.5	95.4	6.3	90.2	20.5	20.0	1.0
F48	91.0	84.2	6.7	6.7	0.5	93.7	95.7	96.5	7.0	90.7	10.0	11.0	0.7
Avg.	91.3	83.9	7.4	6.7	0.4	94.2	95.8	96.8	6.7	91.6	13.2	13.1	1.1
Std Dv	0.4	0.7	0.7	0.4	0.1	0.6	0.9	0.9	0.4	1.0	3.4	3.2	0.3
90% CI	0.3	0.5	0.5	0.3	0.0	0.4	0.6	0.7	0.3	0.8	2.5	2.4	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-1.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1 CENTERLINE - CENTER JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
G38	85.9	76.8	9.2	6.8	0.4	89.2	89.0	90.7	6.9	82.6	22.0	16.5	1.8
G39	85.1	76.0	9.1	6.9	0.4	88.2	88.0	89.7	6.9	81.7	21.0	16.5	2.1
G40	85.8	77.5	8.4	6.9	0.4	89.3	89.9	91.9	6.5	83.6	16.5	14.0	2.0
G41	85.6	76.2	9.4	6.6	0.3	88.8	88.4	90.3	6.6	82.5	27.5	20.0	1.9
Avg.	85.6	76.6	9.0	6.8	0.4	88.9	88.8	90.7	6.7	82.6	21.7	16.7	1.9
Std Dv	0.4	0.7	0.5	0.2	0.0	0.5	0.8	0.9	0.2	0.8	4.5	2.5	0.1
90% CI	0.5	0.8	0.5	0.2	0.0	0.6	1.0	1.1	0.3	0.9	5.3	2.9	0.2
APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
H34	89.8	81.7	8.1	6.2	0.3	92.5	93.9	94.7	6.2	90.6	20.0	18.5	0.8
H35	89.5	80.0	9.5	6.6	0.3	91.9	92.4	92.9	7.6	88.1	27.0	15.5	0.8
H36	89.5	80.6	8.9	6.1	0.3	92.2	93.0	93.9	6.8	88.7	29.0	16.5	1.0
H37	89.5	81.3	8.2	6.8	0.4	92.2	93.2	94.1	7.1	89.0	16.0	14.0	0.9
Avg.	89.6	80.9	8.7	6.4	0.3	92.2	93.1	93.9	6.9	89.1	23.0	16.1	0.8
Std Dv	0.2	0.7	0.7	0.4	0.1	0.3	0.6	0.8	0.6	1.1	6.1	1.9	0.1
90% CI	0.2	0.9	0.8	0.4	0.1	0.3	0.8	0.9	0.7	1.3	7.1	2.2	0.1
500 FT. FLYOVER -- TARGET IAS 145 MPH													
M49	86.0	78.0	8.0	7.3	0.5	89.4	90.2	91.8	7.0	89.7	12.5	12.0	1.6
M50	85.7	80.3	5.4	5.8	0.4	89.6	92.6	94.2	6.0	90.6	8.5	8.0	1.6
M51	86.0	78.9	7.2	6.8	0.5	89.7	91.1	92.6	6.7	88.3	11.5	11.5	1.6
M52	85.5	78.9	6.6	6.5	0.4	89.4	91.7	93.4	6.1	90.4	10.5	9.5	1.7
M53	86.0	79.6	6.3	5.6	0.3	89.7	91.7	93.1	5.9	88.5	13.5	13.5	1.4
Avg.	85.8	79.1	6.7	6.4	0.4	89.6	91.5	93.0	6.3	89.5	11.3	10.9	1.6
Std Dv	0.2	0.9	1.0	0.7	0.1	0.2	0.9	0.9	0.5	1.1	1.9	2.2	0.1
90% CI	0.2	0.8	0.9	0.7	0.1	0.2	0.8	0.9	0.5	1.0	1.8	2.1	0.1
500 FT. FLYOVER -- TARGET IAS 86.0 MPH													
M54	83.8	74.7	9.1	6.5	0.3	87.0	86.9	88.1	6.7	82.9	24.5	21.5	1.2
M55	83.8	76.1	7.7	6.4	0.4	86.8	88.7	89.5	6.2	83.7	15.5	15.0	0.8
M56	83.6	74.6	9.0	6.8	0.4	86.8	86.9	88.0	6.8	82.4	21.0	20.0	1.1
Avg.	83.7	75.1	8.6	6.6	0.4	86.9	87.5	88.5	6.6	83.0	20.3	18.8	1.0
Std Dv	0.1	0.8	0.8	0.2	0.0	0.1	1.0	0.8	0.3	0.6	4.5	3.4	0.2
90% CI	0.1	1.4	1.3	0.3	0.0	0.2	1.8	1.4	0.5	1.0	7.6	5.7	0.4

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-1G.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

SUMMARY NOISE LEVEL DATA

AS MEASURED *

DOT/TSC
2/9/84

SITE: 1G CENTERLINE-CENTER (FLUSH) JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	89.3	82.0	7.3	6.6	0.4	93.3	94.6	96.1	6.6	93.5	13.0	12.5	1.5
A2	90.3	83.0	7.3	6.3	0.4	94.5	95.8	97.4	6.5	94.0	14.5	12.5	1.6
A3	89.7	83.7	6.0	6.3	0.4	94.0	96.1	97.9	6.4	93.8	9.0	9.0	1.8
A4	90.3	82.6	7.8	6.7	0.4	94.5	95.3	96.9	6.7	93.7	14.5	13.5	1.6
A5	88.8	81.6	7.2	6.7	0.5	92.8	93.9	95.6	6.9	92.9	11.5	11.0	1.8
A6	90.2	82.6	7.6	6.6	0.4	94.5	95.2	96.7	7.0	93.4	14.0	13.0	1.5
Avg.	89.8	82.6	7.2	6.5	0.4	93.9	95.1	96.8	6.7	93.5	12.7	11.9	1.6
Std Dv	0.6	0.7	0.6	0.2	0.0	0.7	0.8	0.8	0.2	0.4	2.2	1.7	0.1
90% CI	0.5	0.6	0.5	0.2	0.0	0.6	0.7	0.7	0.2	0.3	1.8	1.4	0.1
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	89.2	81.4	7.8	6.7	0.4	93.3	94.1	95.6	6.8	91.1	14.5	13.5	1.5
B9	88.0	80.4	7.6	7.0	0.5	92.1	93.1	94.7	6.9	89.7	12.5	11.5	1.6
B10	88.4	80.3	8.1	6.8	0.4	92.5	92.8	94.1	7.2	90.3	15.5	14.5	1.6
B11	87.7	80.1	7.6	6.8	0.4	91.8	92.6	94.2	6.9	89.5	13.0	12.5	1.6
B12	88.8	80.1	8.7	6.4	0.3	92.6	92.6	93.6	7.2	90.0	22.5	17.5	1.1
B13	87.7	79.7	8.0	7.1	0.5	91.9	91.9	93.6	7.5	89.1	13.5	13.0	1.6
Avg.	88.3	80.3	8.0	6.8	0.4	92.3	92.8	94.3	7.1	89.9	15.2	13.7	1.5
Std Dv	0.6	0.6	0.4	0.2	0.1	0.6	0.7	0.8	0.2	0.7	3.7	2.1	0.2
90% CI	0.5	0.5	0.3	0.2	0.0	0.5	0.6	0.6	0.2	0.6	3.1	1.7	0.2
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	86.9	78.7	8.1	6.8	0.4	90.8	91.1	92.5	7.1	87.6	15.5	15.0	1.4
C15	87.3	79.0	8.3	6.9	0.4	91.5	91.7	92.8	7.2	88.5	16.0	16.0	1.1
C16	86.3	77.8	8.5	7.1	0.5	90.4	90.6	91.6	7.4	87.3	15.5	15.5	1.0
C17	87.0	78.7	8.3	6.9	0.4	91.1	91.3	92.2	7.4	87.8	16.0	16.0	0.9
C18	86.5	77.9	8.6	7.0	0.4	90.3	90.9	92.2	6.7	87.1	17.0	16.5	1.2
Avg.	86.8	78.4	8.4	6.9	0.4	90.8	91.1	92.2	7.2	87.7	16.0	15.8	1.1
Std Dv	0.4	0.5	0.2	0.1	0.0	0.5	0.4	0.5	0.3	0.6	0.6	0.6	0.2
90% CI	0.4	0.5	0.2	0.1	0.0	0.5	0.4	0.4	0.3	0.5	0.6	0.5	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-1G.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1G CENTERLINE-CENTER (FLUSH) JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER -- TARGET 130.5 MPH													
D19	85.1	75.0	10.1	6.9	0.3	88.9	87.7	89.7	6.4	86.0	29.5	26.5	2.0
D20	84.8	75.4	9.4	6.8	0.4	88.5	86.9	88.9	6.9	86.0	24.5	24.0	2.0
D21	85.2	75.6	9.6	7.0	0.4	89.0	87.9	89.7	6.8	85.1	23.5	23.0	1.8
D22	84.3	75.7	8.6	6.9	0.4	87.8	87.7	89.7	6.7	86.1	17.5	16.0	2.1
D23	84.6	75.1	9.5	7.0	0.4	88.2	86.6	88.6	7.2	84.6	23.0	21.5	1.9
D24	84.5	75.3	9.3	7.1	0.4	88.1	87.1	89.1	7.3	85.7	20.0	17.5	2.0
D25	84.8	75.1	9.8	6.7	0.3	88.4	87.2	89.1	6.7	85.5	28.0	24.5	1.9
Avg.	84.8	75.3	9.5	6.9	0.4	88.4	87.3	89.3	6.9	85.6	23.7	21.9	2.0
Std Dv	0.3	0.3	0.5	0.1	0.0	0.4	0.5	0.5	0.3	0.6	4.2	3.8	0.1
90% CI	0.2	0.2	0.3	0.1	0.0	0.3	0.3	0.3	0.2	0.4	3.1	2.8	0.1
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	86.8	77.4	9.4	7.0	0.4	90.3	89.1	90.4	7.2	83.8	22.0	23.5	1.3
E27	86.4	76.1	10.3	7.1	0.4	89.8	87.5	89.2	7.4	82.6	28.5	27.5	1.8
E28	87.6	77.7	9.8	7.0	0.4	91.1	89.2	90.7	7.5	83.8	25.0	25.0	1.5
E29	86.8	77.0	9.8	7.2	0.4	90.1	88.6	90.0	7.5	83.3	23.0	22.0	1.5
E30	85.8	74.3	11.5	7.8	0.5	89.4	86.9	88.2	7.9	83.0	30.0	26.0	1.4
E31	86.1	77.0	9.1	6.9	0.4	89.7	88.6	90.6	7.0	83.7	21.0	20.0	2.0
E32	86.9	76.5	10.4	7.3	0.4	90.2	88.2	89.6	7.8	82.6	27.0	23.0	1.4
E33	87.0	78.1	8.9	7.0	0.4	90.6	89.7	91.4	7.3	84.0	19.0	18.0	1.9
Avg.	86.7	76.8	9.9	7.1	0.4	90.2	88.5	90.0	7.4	83.4	24.4	23.1	1.6
Std Dv	0.6	1.2	0.8	0.3	0.0	0.5	0.9	1.0	0.3	0.6	3.8	3.1	0.3
90% CI	0.4	0.8	0.6	0.2	0.0	0.4	0.6	0.7	0.2	0.4	2.6	2.1	0.2
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42	94.9	86.9	8.0	7.5	0.5	97.4	98.6	99.2	7.5	94.4	11.5	12.5	0.6
F43	95.5	87.9	7.6	6.9	0.5	98.2	99.4	99.8	7.3	94.9	12.5	14.0	0.4
F44	94.8	88.3	6.5	6.5	0.4	97.6	99.9	100.9	6.4	96.3	10.0	11.5	0.9
F45	95.4	87.3	8.1	7.3	0.5	98.4	99.4	100.0	7.5	95.4	13.0	13.0	1.0
F46	95.4	88.7	6.7	6.7	0.5	98.1	100.1	100.5	6.7	95.1	10.0	13.5	0.5
F47	94.8	87.3	7.5	7.4	0.5	97.3	98.9	99.6	7.2	95.0	10.5	11.5	0.7
F48	95.2	87.6	7.5	7.1	0.5	97.8	99.5	99.9	7.2	95.1	11.5	12.5	0.4
Avg.	95.1	87.7	7.4	7.1	0.5	97.8	99.4	100.0	7.1	95.2	11.3	12.6	0.6
Std Dv	0.3	0.6	0.6	0.4	0.0	0.4	0.5	0.6	0.4	0.6	1.2	0.9	0.2
90% CI	0.2	0.5	0.4	0.3	0.0	0.3	0.4	0.4	0.3	0.4	0.9	0.7	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-1G.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1G   CENTERLINE-CENTER (FLUSH)   JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
G38	89.3	80.4	8.9	7.0	0.4	92.7	92.7	94.2	7.1	86.8	18.5	15.5	1.5
G39	88.4	79.5	8.9	7.3	0.5	91.8	91.2	92.6	7.5	85.9	16.5	17.0	1.4
G40	89.3	80.6	8.7	6.8	0.4	92.7	92.6	93.9	7.3	87.2	19.0	16.0	1.3
G41	89.0	80.1	9.0	7.0	0.4	92.3	91.9	93.3	7.2	86.1	19.0	18.0	1.4
Avg.	89.0	80.1	8.9	7.0	0.4	92.4	92.1	93.5	7.3	86.5	18.2	16.6	1.4
Std Dv	0.4	0.5	0.1	0.2	0.0	0.4	0.7	0.7	0.2	0.6	1.2	1.1	0.1
90% CI	0.5	0.5	0.1	0.2	0.0	0.5	0.8	0.8	0.2	0.7	1.4	1.3	0.1
APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
H34	93.8	86.3	7.5	6.3	0.4	96.4	98.2	98.6	6.5	93.6	15.5	16.0	0.4
H35	93.4	84.7	8.7	7.4	0.5	96.1	96.5	97.4	7.3	92.5	15.0	15.5	0.9
H36	93.3	85.2	8.2	7.1	0.5	96.2	96.8	97.7	7.3	92.6	14.0	15.0	1.0
H37	93.6	85.9	7.6	6.8	0.4	96.1	97.7	98.2	7.1	93.5	13.0	13.0	0.4
Avg.	93.5	85.5	8.0	6.9	0.4	96.2	97.3	98.0	7.0	93.0	14.4	14.9	0.7
Std Dv	0.2	0.7	0.5	0.4	0.1	0.2	0.8	0.5	0.4	0.6	1.1	1.3	0.3
90% CI	0.3	0.8	0.6	0.5	0.1	0.2	0.9	0.6	0.4	0.7	1.3	1.5	0.4

500 FT. FLYOVER -- TARGET IAS 145 MPH

---------- NO DATA ----------

500 FT. FLYOVER -- TARGET IAS 86.0 MPH

---------- NO DATA ----------

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. B.2-2.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 2   SIDELINE - 150 M. SOUTH   JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	84.3	76.5	7.7	6.9	0.4	88.1	88.9	90.5	6.7	87.4	13.5	13.5	1.9
A2	83.8	75.5	8.3	7.1	0.5	87.3	87.3	88.4	7.0	90.8	15.0	18.5	1.1
A3	84.9	77.1	7.8	7.0	0.5	88.0	88.9	90.3	6.9	87.4	13.0	13.5	1.4
A4	84.3	75.6	8.6	7.1	0.4	87.9	87.9	88.8	6.7	91.0	16.5	23.0	0.9
A5	84.4	76.7	7.7	6.9	0.5	88.2	89.3	90.7	6.7	86.8	13.0	13.0	1.4
A6	84.4	76.0	8.4	6.4	0.3	88.0	88.1	89.3	6.6	90.4	21.0	20.5	1.2
Avg.	84.3	76.2	8.1	6.9	0.4	87.9	88.4	89.7	6.8	89.0	15.3	17.0	1.3
Std Dv	0.4	0.6	0.4	0.3	0.1	0.3	0.7	1.0	0.1	2.0	3.1	4.3	0.3
90% CI	0.3	0.5	0.3	0.2	0.0	0.3	0.6	0.8	0.1	1.6	2.5	3.5	0.3
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	83.0	74.0	8.9	7.4	0.5	86.2	86.2	87.1	7.0	85.5	16.0	20.5	1.0
B9	83.3	74.8	8.6	6.9	0.4	86.6	86.7	88.5	6.8	84.9	17.5	15.5	1.8
B10	82.7	73.4	9.3	7.2	0.4	86.0	85.4	86.4	6.5	84.7	19.5	29.5	1.1
B11	82.8	74.8	8.0	6.4	0.3	86.0	86.6	87.7	6.7	84.4	18.0	17.5	1.1
B12	83.1	73.8	9.2	6.1	0.3	-	86.3	87.1	-	84.5	32.0	-	0.9
B13	82.6	74.0	8.6	7.1	0.4	86.3	86.2	87.3	7.1	84.5	16.5	18.5	1.6
Avg.	82.9	74.1	8.8	6.9	0.4	86.2	86.2	87.4	6.8	84.7	19.9	20.3	1.2
Std Dv	0.3	0.6	0.5	0.5	0.1	0.3	0.5	0.7	0.2	0.4	6.0	5.4	0.4
90% CI	0.2	0.5	0.4	0.4	0.1	0.2	0.4	0.6	0.2	0.3	5.0	5.2	0.3
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	81.9	72.5	9.4	7.0	0.4	85.2	84.5	85.9	7.0	83.6	22.0	21.5	1.4
C15	82.7	73.6	9.2	6.5	0.3	86.0	85.9	86.9	6.4	83.0	26.0	26.0	1.0
C16	82.5	73.3	9.2	7.2	0.4	85.8	84.6	85.6	7.3	83.8	19.0	24.0	1.6
C17	82.7	73.7	9.0	6.8	0.4	85.9	86.0	87.2	6.6	83.0	21.0	20.5	1.1
C18	82.7	73.6	9.1	6.8	0.4	86.0	85.2	87.0	6.7	84.4	22.0	22.0	1.8
Avg.	82.5	73.3	9.2	6.9	0.4	85.8	85.2	86.5	6.8	83.6	22.0	22.8	1.4
Std Dv	0.3	0.5	0.2	0.3	0.0	0.3	0.7	0.7	0.4	0.6	2.5	2.2	0.3
90% CI	0.3	0.5	0.2	0.3	0.0	0.3	0.7	0.7	0.3	0.6	2.4	2.1	0.3

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-2.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 2 SIDELINE - 150 M. SOUTH JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER -- TARGET IAS 130.5 MPH													
D19	81.8	71.9	9.9	7.1	0.4	84.6	84.2	85.5	6.8	86.5	24.0	22.5	1.2
D20	81.7	72.1	9.6	7.2	0.4	85.7	85.0	87.0	6.7	84.1	22.0	19.5	2.0
D21	82.0	72.9	9.1	6.3	0.3	84.9	84.5	85.9	6.3	85.3	27.5	27.0	1.4
D22	82.3	72.9	9.5	7.6	0.5	86.4	86.1	88.1	7.0	84.0	17.5	15.5	2.0
D23	80.6	70.7	10.0	7.3	0.4	83.3	82.3	83.2	7.4	85.4	23.0	23.5	1.3
D24	82.0	72.9	9.1	7.0	0.4	85.8	85.1	87.0	7.1	83.5	19.5	17.5	1.9
D25	81.4	71.1	10.2	6.9	0.3	-	82.1	83.2	-	84.6	30.5	-	1.2
Avg.	81.7	72.1	9.6	7.1	0.4	85.1	84.2	85.7	6.9	84.8	23.4	20.9	1.6
Std Dv	0.5	0.9	0.5	0.4	0.1	1.1	1.5	1.9	0.4	1.0	4.5	4.2	0.4
90% CI	0.4	0.7	0.3	0.3	0.0	0.9	1.1	1.4	0.3	0.8	3.3	3.5	0.3
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	86.1	74.1	12.1	7.6	0.4	88.2	85.6	86.9	7.1	81.0	38.0	39.5	1.9
E27	85.3	74.8	10.5	7.3	0.4	87.8	85.9	88.1	7.0	81.4	27.5	24.0	2.2
E28	85.8	74.6	11.2	7.2	0.4	88.3	86.9	89.1	6.5	82.0	35.5	25.5	2.2
E29	85.4	73.4	11.9	7.5	0.4	87.6	85.5	87.7	7.2	81.2	39.0	24.0	2.2
E30	85.2	73.9	11.4	7.6	0.4	88.0	85.7	88.0	6.9	81.3	31.0	29.0	2.2
E31	85.6	74.0	11.6	7.7	0.5	88.0	85.8	87.7	7.0	81.3	32.0	30.5	2.1
E32	85.2	73.8	11.4	7.5	0.4	87.5	85.7	87.6	7.0	81.0	33.0	26.5	1.9
E33	85.4	74.7	10.7	7.3	0.4	88.1	85.6	87.7	7.1	81.4	29.5	29.0	2.1
Avg.	85.5	74.1	11.3	7.5	0.4	87.9	85.8	87.8	7.0	81.3	33.2	28.5	2.1
Std Dv	0.3	0.5	0.5	0.2	0.0	0.3	0.4	0.6	0.2	0.3	4.0	5.1	0.1
90% CI	0.2	0.3	0.4	0.1	0.0	0.2	0.3	0.4	0.1	0.2	2.7	3.4	0.1
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42	85.7	74.9	10.8	7.7	0.5	88.6	86.7	87.8	8.0	83.6	25.5	22.5	1.1
F43	84.9	75.1	9.7	7.1	0.4	88.3	87.7	88.7	7.1	83.9	23.5	22.5	1.3
F44	85.0	75.5	9.5	6.3	0.3	88.1	87.5	88.7	6.7	84.6	32.0	26.0	1.2
F45	84.8	73.8	11.0	8.1	0.6	88.1	85.4	86.8	8.3	84.4	23.0	22.5	1.4
F46	85.5	75.0	10.5	6.6	0.3	88.5	87.1	88.5	7.6	85.2	38.5	20.5	1.3
F47	85.1	74.1	11.0	7.9	0.5	88.3	86.8	88.0	7.4	85.0	25.0	24.0	1.2
F48	84.6	74.0	10.5	7.5	0.4	88.0	86.7	87.8	7.3	85.2	25.5	25.0	1.1
Avg.	85.1	74.6	10.5	7.3	0.4	88.3	86.8	88.0	7.5	84.6	27.6	23.3	1.2
Std Dv	0.4	0.7	0.6	0.7	0.1	0.2	0.7	0.7	0.6	0.6	5.7	1.8	0.1
90% CI	0.3	0.5	0.4	0.5	0.1	0.2	0.5	0.5	0.4	0.5	4.2	1.4	0.1

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-2.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 2 SIDELINE - 150 M. SOUTH JUNE 7,1983

TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
G38	85.2	74.8	10.4	7.4	0.4	87.6	86.1	87.2	7.4	83.3	26.0	26.0	1.1
G39	85.3	75.5	9.9	7.3	0.4	87.9	86.9	87.9	7.5	82.9	23.0	22.0	1.0
G40	85.0	74.9	10.1	7.2	0.4	87.4	86.5	87.6	7.2	83.8	25.0	23.5	1.1
G41	85.2	74.1	11.1	7.5	0.4	-	85.7	87.0	-	82.1	29.5	-	1.2
Avg.	85.2	74.8	10.4	7.4	0.4	87.7	86.3	87.4	7.3	83.0	25.9	23.8	1.1
Std Dv	0.1	0.5	0.5	0.1	0.0	0.2	0.5	0.4	0.1	0.7	2.7	2.0	0.1
90% CI	0.1	0.6	0.6	0.2	0.0	0.4	0.6	0.5	0.2	0.8	3.2	3.4	0.1

APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
H34	84.8	73.9	11.0	7.1	0.4	87.4	85.3	86.1	7.4	84.4	34.5	34.5	0.7
H35	85.8	73.7	12.2	8.0	0.5	88.5	86.0	88.0	7.0	86.0	33.5	31.0	2.4
H36	85.0	73.1	11.9	7.7	0.4	87.9	85.3	86.1	7.7	84.4	34.5	34.0	0.8
H37	84.3	73.6	10.7	7.6	0.5	87.3	86.2	87.6	6.9	85.3	25.5	24.5	1.5
Avg.	85.0	73.6	11.4	7.6	0.4	87.8	85.7	86.9	7.3	85.0	32.0	31.0	1.3
Std Dv	0.6	0.3	0.7	0.3	0.1	0.6	0.5	1.0	0.3	0.8	4.4	4.6	0.8
90% CI	0.7	0.4	0.8	0.4	0.1	0.7	0.5	1.2	0.4	0.9	5.1	5.4	0.9

500 FT. FLYOVER -- TARGET IAS 145 MPH

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
M49	85.0	76.5	8.4	6.9	0.4	88.5	88.3	89.5	7.3	92.0	17.0	17.0	1.2
M50	85.1	78.1	6.9	6.5	0.4	88.5	89.9	91.3	6.8	89.4	11.5	11.5	1.4
M51	84.8	76.6	8.2	6.4	0.3	88.4	88.5	89.5	7.0	92.1	19.0	18.5	1.2
M52	86.2	79.4	6.8	6.3	0.4	89.6	91.9	93.3	6.0	90.3	12.0	11.5	1.3
M53	84.9	76.2	8.7	6.7	0.4	88.2	88.2	89.2	7.1	90.7	19.5	18.5	1.0
Avg.	85.2	77.4	7.8	6.6	0.4	88.6	89.4	90.6	6.8	90.9	15.8	15.4	1.2
Std Dv	0.6	1.3	0.9	0.2	0.0	0.6	1.6	1.7	0.5	1.2	3.8	3.6	0.2
90% CI	0.5	1.3	0.8	0.2	0.0	0.5	1.5	1.6	0.5	1.1	3.6	3.4	0.1

500 FT. FLYOVER -- TARGET IAS 86.0 MPH

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
N54	82.3	72.1	10.2	7.3	0.4	85.4	84.4	85.4	7.1	82.1	25.5	25.5	1.1
N55	81.9	73.5	8.4	6.8	0.4	85.1	86.1	87.5	6.5	84.5	17.5	14.5	1.4
N56	82.3	72.0	10.3	7.2	0.4	85.1	84.1	85.1	7.3	82.1	27.0	24.0	1.0
Avg.	82.2	72.5	9.6	7.1	0.4	85.2	84.9	86.0	7.0	82.9	23.3	21.3	1.1
Std Dv	0.2	0.8	1.1	0.3	0.0	0.2	1.1	1.3	0.4	1.4	5.1	6.0	0.2
90% CI	0.4	1.4	1.8	0.5	0.0	0.3	1.9	2.2	0.7	2.3	8.6	10.1	0.4

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-3.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 3 SIDELINE - 150 M. NORTH JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	83.2	74.9	8.3	6.8	0.4	86.5	86.8	87.9	7.2	88.1	16.5	16.0	1.1
A2	84.8	76.4	8.3	7.1	0.5	88.3	88.1	89.6	7.0	86.9	15.0	17.0	1.6
A3	83.4	75.4	8.0	6.7	0.4	86.5	87.4	88.5	6.7	88.6	15.5	15.5	1.3
A4	85.1	77.0	8.1	6.9	0.4	88.3	88.6	89.9	7.2	87.0	15.0	15.0	1.6
A5	82.9	74.9	8.0	6.7	0.4	85.8	87.0	88.0	6.7	87.6	15.5	14.5	1.5
A6	84.8	76.8	8.0	6.8	0.4	88.1	88.4	89.6	7.1	87.0	15.0	15.5	1.2
Avg.	84.0	75.9	8.1	6.8	0.4	87.3	87.7	88.9	7.0	87.5	15.4	15.6	1.4
Std Dv	1.0	0.9	0.1	0.1	0.0	1.1	0.8	0.9	0.2	0.7	0.6	0.9	0.2
90% CI	0.8	0.8	0.1	0.1	0.0	0.9	0.6	0.7	0.2	0.6	0.5	0.7	0.2
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	83.6	74.7	8.9	7.2	0.4	86.8	86.4	87.6	7.3	84.5	17.5	18.0	1.1
B9	82.1	73.0	9.1	7.3	0.5	84.8	85.2	86.0	7.3	83.4	17.5	16.5	0.9
B10	83.7	74.9	8.8	7.1	0.4	86.6	86.1	87.5	7.3	83.8	17.5	17.5	1.4
B11	82.1	73.3	8.9	6.9	0.4	85.2	85.9	87.0	6.8	82.4	19.5	16.5	1.1
B12	83.5	74.2	9.3	7.3	0.5	86.7	86.6	87.3	7.4	84.1	18.5	18.5	0.9
B13	81.2	72.6	8.7	7.2	0.5	84.2	84.8	86.0	6.9	82.2	16.0	15.5	1.2
Avg.	82.7	73.8	8.9	7.2	0.4	85.7	85.8	86.9	7.2	83.4	17.7	17.1	1.1
Std Dv	1.0	1.0	0.2	0.2	0.0	1.1	0.7	0.7	0.3	0.9	1.2	1.1	0.2
90% CI	0.8	0.8	0.2	0.1	0.0	0.9	0.6	0.6	0.2	0.8	1.0	0.9	0.1
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	81.6	72.9	8.7	6.7	0.4	84.4	84.7	85.8	6.8	80.2	20.0	19.0	1.1
C15	82.8	73.7	9.1	7.4	0.5	86.2	85.5	87.2	7.2	84.7	17.0	18.0	1.7
C16	81.4	72.7	8.7	7.0	0.4	84.2	85.4	86.4	7.0	81.0	17.5	13.0	1.0
C17	83.1	74.4	8.7	7.1	0.4	86.3	86.1	87.7	6.6	84.2	16.5	20.5	1.7
C18	81.6	73.6	8.1	6.8	0.4	84.6	85.8	86.6	6.8	82.3	15.5	15.0	0.8
Avg.	82.1	73.4	8.7	7.0	0.4	85.2	85.5	86.7	6.9	82.5	17.3	17.1	1.3
Std Dv	0.8	0.7	0.4	0.3	0.0	1.0	0.5	0.7	0.2	1.9	1.7	3.0	0.4
90% CI	0.8	0.7	0.4	0.3	0.0	1.0	0.5	0.7	0.2	1.9	1.6	2.9	0.4

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-3.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 3 SIDELINE - 150 M. NORTH JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER --TARGET IAS 130.5 MPH													
D19	83.6	73.6	10.0	7.7	0.5	87.3	86.1	87.8	7.4	84.1	20.0	19.0	1.7
D20	81.6	73.3	8.3	6.2	0.3	84.5	84.8	85.4	6.8	83.9	21.0	21.5	0.6
D21	83.2	73.2	10.0	7.1	0.4	86.6	85.7	87.2	7.0	82.7	25.5	22.0	1.6
D22	80.5	71.4	9.1	6.6	0.3	-	82.1	83.5	-	83.1	24.0	-	1.6
D23	82.3	72.3	10.1	7.5	0.5	86.0	85.2	87.1	7.0	82.8	22.0	18.5	1.9
D24	81.8	72.4	9.4	7.1	0.4	84.8	84.1	85.8	6.9	84.4	21.5	20.0	1.8
D25	82.7	73.0	9.7	6.9	0.4	86.2	85.9	87.8	6.6	82.6	26.0	19.0	1.9
Avg.	82.2	72.7	9.5	7.0	0.4	85.9	84.9	86.4	7.0	83.4	22.9	20.0	1.6
Std Dv	1.1	0.8	0.6	0.5	0.1	1.1	1.4	1.6	0.3	0.7	2.3	1.4	0.5
90% CI	0.8	0.6	0.5	0.4	0.0	0.9	1.0	1.2	0.2	0.5	1.7	1.2	0.3
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	89.4	79.1	10.3	7.3	0.4	91.5	89.4	91.2	7.4	82.4	25.5	25.0	2.0
E27	85.4	74.8	10.5	7.0	0.4	88.1	85.7	88.1	7.0	80.7	31.5	27.0	2.4
E28	85.3	74.6	10.8	7.6	0.4	88.1	85.1	87.1	7.8	81.5	26.5	25.5	2.6
E29	85.4	75.0	10.4	7.6	0.5	88.2	85.7	88.1	7.5	81.9	23.5	22.5	2.4
E30	85.3	75.1	10.2	7.2	0.4	87.6	85.3	87.5	7.2	80.9	26.0	25.0	2.2
E31	88.5	78.0	10.5	7.3	0.4	90.6	88.4	90.8	7.0	81.4	27.5	25.0	2.4
E32	85.2	75.9	9.3	6.8	0.4	88.1	86.6	88.5	7.0	81.0	24.0	23.5	1.9
E33	85.0	74.4	10.6	7.3	0.4	88.0	85.0	87.3	7.4	80.8	28.5	28.0	2.4
Avg.	86.2	75.9	10.3	7.3	0.4	88.8	86.4	88.6	7.3	81.3	26.6	25.2	2.3
Std Dv	1.7	1.7	0.4	0.3	0.0	1.4	1.6	1.6	0.3	0.6	2.6	1.8	0.2
90% CI	1.2	1.2	0.3	0.2	0.0	1.0	1.1	1.1	0.2	0.4	1.7	1.2	0.2
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42	88.6	80.9	7.7	7.1	0.5	91.7	92.2	93.8	7.4	88.7	12.0	12.0	1.6
F43	87.5	79.2	8.3	6.4	0.3	90.5	91.6	93.5	5.6	88.1	19.5	18.0	1.8
F44	90.2	82.6	7.6	6.2	0.3	93.0	94.4	95.9	5.8	90.0	17.0	16.5	1.6
F45	88.8	80.2	8.5	6.9	0.4	91.7	91.4	93.3	6.9	87.5	17.0	16.5	1.9
F46	88.8	79.6	9.2	7.4	0.5	92.0	91.4	93.4	7.2	87.8	17.0	16.0	2.0
F47	89.4	79.9	9.5	7.8	0.5	92.2	91.8	93.4	7.2	88.1	16.5	16.0	1.6
F48	88.9	80.3	8.5	6.6	0.4	91.6	91.9	94.3	6.3	88.5	19.5	14.5	2.4
Avg.	88.9	80.4	8.5	6.9	0.4	91.8	92.1	93.9	6.6	88.4	16.9	15.6	1.8
Std Dv	0.8	1.1	0.7	0.6	0.1	0.7	1.0	0.9	0.7	0.8	2.5	1.9	0.3
90% CI	0.6	0.8	0.5	0.4	0.1	0.5	0.8	0.7	0.5	0.6	1.8	1.4	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-3.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

SUMMARY NOISE LEVEL DATA

AS MEASURED *

DOT/TSC
2/9/84

SITE: 3 SIDELINE - 150 M. NORTH JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
G38	85.4	76.1	9.3	7.2	0.4	88.0	87.0	88.6	7.3	82.1	20.0	20.0	1.6
G39	85.6	75.6	9.9	7.3	0.4	87.8	86.8	88.6	7.0	81.5	22.5	20.5	1.9
G40	85.5	76.0	9.5	7.6	0.5	88.1	86.9	88.5	7.6	83.2	18.0	18.0	1.7
G41	85.6	76.2	9.4	7.1	0.4	87.9	87.8	89.1	6.9	82.8	21.5	19.0	1.3
Avg.	85.5	76.0	9.5	7.3	0.4	88.0	87.1	88.7	7.2	82.4	20.5	19.4	1.6
Std Dv	0.1	0.2	0.3	0.2	0.0	0.1	0.5	0.3	0.3	0.8	2.0	1.1	0.3
90% CI	0.1	0.3	0.3	0.3	0.0	0.1	0.6	0.3	0.4	0.9	2.3	1.3	0.3
APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
H34	89.9	82.2	7.7	6.2	0.3	92.6	93.8	95.5	5.8	89.5	17.5	16.5	1.6
H35	88.9	79.5	9.4	7.6	0.5	91.3	91.6	93.1	6.9	87.7	17.5	15.5	1.8
H36	89.7	81.8	7.9	6.8	0.4	92.6	93.9	95.6	6.3	89.7	14.5	13.0	1.7
H37	89.7	82.4	7.3	6.7	0.4	92.6	93.2	94.6	7.4	89.2	12.0	12.0	1.5
Avg.	89.6	81.5	8.1	6.8	0.4	92.3	93.1	94.7	6.6	89.0	15.4	14.2	1.7
Std Dv	0.5	1.4	0.9	0.6	0.1	0.7	1.0	1.1	0.7	0.9	2.7	2.1	0.1
90% CI	0.5	1.6	1.1	0.7	0.1	0.8	1.2	1.3	0.8	1.1	3.1	2.5	0.1
500 FT. FLYOVER -- TARGET IAS 145 MPH													
M49	86.8	79.4	7.3	6.6	0.4	90.3	91.8	92.8	6.6	90.2	13.0	13.5	1.0
M50	84.3	77.0	7.3	6.5	0.4	87.5	89.0	89.9	6.7	91.7	13.5	13.5	1.0
M51	86.8	78.7	8.1	7.4	0.5	89.6	90.3	91.5	7.4	88.1	12.5	12.5	1.2
M52	84.3	77.0	7.3	6.6	0.4	87.3	88.5	89.3	7.1	90.7	13.0	13.5	1.3
M53	85.6	77.5	8.1	6.7	0.4	88.8	88.9	90.4	6.6	87.1	16.5	19.0	1.5
Avg.	85.6	77.9	7.7	6.8	0.4	88.7	89.7	90.8	6.9	89.6	13.7	14.4	1.2
Std Dv	1.2	1.1	0.4	0.4	0.1	1.3	1.4	1.4	0.4	1.9	1.6	2.6	0.2
90% CI	1.2	1.0	0.4	0.4	0.0	1.2	1.3	1.3	0.3	1.8	1.5	2.5	0.2
500 FT. FLYOVER -- TARGET IAS 86.0 MPH													
M54		----------		NO DATA		----------							
M55	81.3	72.3	8.9	7.5	0.5	84.2	84.4	85.2	7.3	82.0	15.5	17.0	1.4
M56	83.1	72.9	10.1	7.0	0.4	85.9	84.1	85.6	7.1	82.4	28.0	28.5	1.5
Avg.	82.2	72.6	9.5	7.2	0.4	85.1	84.3	85.4	7.2	82.2	21.7	22.7	1.4
Std Dv	1.3	0.4	0.8	0.4	0.1	1.2	0.2	0.3	0.2	0.3	8.8	8.1	0.1
90% CI	5.7	2.0	3.7	1.7	0.4	5.4	0.7	1.4	0.8	1.5	39.5	36.3	0.3

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-4.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

SUMMARY NOISE LEVEL DATA

AS MEASURED *

DOT/TSC
2/9/84

SITE: 4 CENTERLINE - 150 M. WEST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	84.5	77.4	7.1	6.6	0.4	88.1	89.4	90.9	6.9	86.8	12.0	11.0	1.6
A2	85.3	77.2	8.1	6.9	0.4	88.7	89.6	90.9	6.8	86.8	15.0	14.0	1.4
A3	85.0	78.5	6.5	6.4	0.4	88.8	90.9	92.5	6.5	87.6	10.5	9.5	1.6
A4	85.2	77.8	7.4	6.6	0.4	88.8	90.0	91.3	6.7	86.8	13.5	13.0	1.1
A5	83.7	75.7	8.0	7.2	0.5	87.4	88.1	89.7	7.1	86.2	13.0	12.0	1.5
A6	85.3	77.3	8.0	7.3	0.5	88.9	89.7	91.1	6.9	87.1	12.5	13.5	1.4
Avg.	84.8	77.3	7.5	6.8	0.4	88.4	89.6	91.1	6.8	86.9	12.7	12.2	1.4
Std Dv	0.6	0.9	0.6	0.4	0.0	0.6	0.9	0.9	0.2	0.5	1.5	1.7	0.2
90% CI	0.5	0.8	0.5	0.3	0.0	0.5	0.7	0.7	0.2	0.4	1.2	1.4	0.1
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	84.2	76.1	8.1	6.8	0.4	87.7	88.7	90.0	6.6	83.9	16.0	15.0	1.7
B9	83.7	76.1	7.6	6.8	0.4	87.2	89.4	90.9	6.1	84.7	13.0	11.0	1.4
B10	83.6	75.1	8.5	6.8	0.4	87.4	87.6	88.8	6.3	83.1	17.5	23.0	1.2
B11	83.5	75.9	7.5	6.5	0.4	87.1	88.5	89.7	6.6	83.8	14.5	13.5	1.2
B12	82.9	73.7	9.2	7.2	0.4	86.4	86.4	87.4	6.9	82.4	19.0	20.0	1.2
B13	82.3	74.7	7.6	6.8	0.4	86.0	87.1	88.4	6.9	82.6	13.5	12.5	1.4
Avg.	83.4	75.3	8.1	6.8	0.4	87.0	87.9	89.2	6.6	83.4	15.6	15.8	1.4
Std Dv	0.7	1.0	0.6	0.2	0.0	0.6	1.1	1.2	0.3	0.9	2.4	4.7	0.2
90% CI	0.5	0.8	0.5	0.2	0.0	0.5	0.9	1.0	0.3	0.7	1.9	3.8	0.1
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	82.1	74.2	7.9	6.7	0.4	85.6	86.8	88.2	6.5	82.1	15.0	14.0	1.4
C15	83.8	75.3	8.5	6.7	0.4	87.2	87.8	88.9	6.6	83.5	18.5	18.0	1.1
C16	83.1	75.1	8.0	6.9	0.4	86.5	87.7	89.1	6.6	83.2	14.0	13.5	1.4
C17	83.4	74.6	8.8	6.9	0.4	87.0	87.4	88.7	6.5	83.0	18.5	19.0	1.4
C18	83.2	75.1	8.1	6.9	0.4	86.7	87.7	89.1	6.6	83.3	15.0	14.0	1.4
Avg.	83.1	74.9	8.2	6.8	0.4	86.6	87.5	88.8	6.5	83.0	16.2	15.7	1.3
Std Dv	0.6	0.4	0.4	0.1	0.0	0.6	0.4	0.4	0.1	0.6	2.1	2.6	0.1
90% CI	0.6	0.4	0.4	0.1	0.0	0.6	0.4	0.4	0.1	0.5	2.0	2.5	0.1

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-4.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

SUMMARY NOISE LEVEL DATA

AS MEASURED *

DOT/TSC
2/9/84

SITE: 4 CENTERLINE - 150 M. WEST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER -- TARGET IAS 130.5 MPH													
D19	81.1	70.8	10.3	7.4	0.4	84.2	83.2	84.8	7.3	81.5	25.0	19.0	1.6
D20	81.5	72.0	9.5	7.2	0.4	84.9	84.0	86.0	7.3	83.0	21.0	16.5	2.0
D21	82.1	73.0	9.1	6.8	0.4	85.5	84.7	86.2	6.7	81.5	22.0	24.5	1.5
D22	80.7	71.9	8.8	6.7	0.4	83.9	83.5	85.4	6.8	82.4	21.0	17.5	1.9
D23	81.2	70.6	10.6	7.4	0.4	84.2	82.7	84.6	7.2	80.7	27.5	21.5	1.8
D24	80.8	72.3	8.5	6.7	0.4	84.2	84.7	86.5	6.3	81.8	19.0	16.5	1.8
D25	80.7	70.3	10.5	7.4	0.4	84.0	82.3	84.0	7.4	80.9	25.5	22.5	1.7
Avg.	81.2	71.5	9.6	7.1	0.4	84.4	83.6	85.4	7.0	81.7	23.0	19.7	1.8
Std Dv	0.5	1.0	0.9	0.4	0.0	0.6	0.9	0.9	0.4	0.8	3.0	3.2	0.2
90% CI	0.4	0.7	0.6	0.3	0.0	0.4	0.7	0.7	0.3	0.6	2.2	2.3	0.1
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	----------			NO DATA		----------							
E27	82.4	71.6	10.8	7.5	0.4	-	83.1	85.0	-	78.0	27.0	-	1.9
E28	83.6	72.8	10.8	7.3	0.4	86.5	84.3	86.2	7.3	78.0	29.5	26.5	1.9
E29	83.2	71.8	11.4	7.3	0.4	85.9	83.4	85.3	7.3	77.8	37.0	28.0	2.0
E30	82.6	71.9	10.8	7.0	0.3	85.6	83.3	85.1	7.2	77.2	35.0	28.5	1.8
E31	82.6	72.5	10.1	6.8	0.3	85.5	84.2	86.0	6.6	78.4	31.5	27.5	1.8
E32	83.3	71.9	11.4	6.8	0.3	-	83.3	85.3	-	77.1	47.0	-	2.0
E33	83.0	72.6	10.4	7.2	0.4	85.8	84.0	85.8	7.1	78.0	27.0	25.5	1.7
Avg.	83.0	72.2	10.8	7.1	0.4	85.9	83.7	85.5	7.1	77.8	33.4	27.2	1.9
Std Dv	0.4	0.5	0.5	0.3	0.1	0.4	0.5	0.5	0.3	0.5	7.1	1.2	0.1
90% CI	0.3	0.3	0.3	0.2	0.0	0.4	0.4	0.3	0.3	0.3	5.2	1.1	0.1
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42	----------			NO DATA		----------							
F43	91.3	82.9	8.4	6.8	0.4	94.2	94.3	95.4	7.2	88.5	17.0	17.0	1.0
F44	89.3	79.9	9.4	7.4	0.5	92.2	92.7	94.0	6.7	88.7	18.5	16.5	1.3
F45	91.0	82.4	8.5	7.2	0.5	93.6	94.2	95.2	7.1	90.2	15.5	15.5	1.0
F46	91.3	83.6	7.7	6.4	0.4	93.9	95.5	96.5	6.5	90.0	16.0	13.5	1.0
F47	91.3	85.2	6.1	5.9	0.4	94.2	97.1	98.2	5.8	91.7	11.0	11.0	1.1
F48	90.2	83.4	6.8	5.9	0.3	92.7	95.1	96.1	5.9	90.9	14.0	13.5	1.0
Avg.	90.7	82.9	7.8	6.6	0.4	93.5	94.8	95.9	6.5	90.0	15.3	14.5	1.1
Std Dv	0.8	1.7	1.2	0.6	0.1	0.8	1.5	1.4	0.6	1.2	2.6	2.3	0.1
90% CI	0.7	1.4	1.0	0.5	0.0	0.7	1.2	1.2	0.5	1.0	2.1	1.9	0.1

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-4.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 4 CENTERLINE - 150 M. WEST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
G38	85.0	75.6	9.4	7.2	0.4	88.3	87.4	89.0	7.4	81.4	20.5	18.5	1.8
G39	84.7	74.8	9.8	6.7	0.3	87.2	86.4	88.4	7.0	80.8	29.5	18.5	2.0
G40	85.1	75.1	10.0	7.2	0.4	88.2	86.6	88.7	7.5	80.8	24.0	18.5	2.2
G41	84.7	74.0	10.6	7.2	0.4	87.4	85.8	87.6	7.3	79.9	29.5	22.0	1.8
Avg.	84.9	74.9	10.0	7.1	0.4	87.8	86.5	88.4	7.3	80.7	25.9	19.4	1.9
Std Dv	0.2	0.6	0.5	0.3	0.0	0.5	0.6	0.6	0.2	0.6	4.4	1.7	0.2
90% CI	0.2	0.8	0.6	0.3	0.1	0.6	0.8	0.7	0.2	0.7	5.2	2.1	0.2
APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
H34	89.7	81.9	7.9	6.6	0.4	91.8	92.3	92.9	7.2	86.9	15.5	17.0	0.6
H35	89.2	79.6	9.7	6.9	0.4	91.5	91.6	92.7	6.6	87.5	25.0	22.0	1.3
H36	88.9	80.1	8.9	6.5	0.3	91.6	91.3	91.9	7.1	87.1	23.0	23.5	0.9
H37	88.9	81.0	7.9	6.7	0.4	91.7	92.5	93.7	6.8	88.6	15.0	14.5	1.2
Avg.	89.2	80.6	8.6	6.7	0.4	91.6	91.9	92.8	6.9	87.5	19.6	19.2	1.0
Std Dv	0.4	1.0	0.9	0.2	0.0	0.1	0.6	0.8	0.3	0.8	5.1	4.2	0.3
90% CI	0.5	1.2	1.0	0.2	0.0	0.2	0.7	0.9	0.3	0.9	6.0	5.0	0.4
500 FT. FLYOVER -- TARGET IAS 145 MPH													
N49	85.4	77.9	7.6	7.3	0.5	88.8	90.2	91.7	7.0	89.6	11.0	10.5	1.5
N50	85.7	79.3	6.4	6.7	0.5	89.7	92.4	94.0	6.3	89.9	9.0	8.0	1.6
N51	86.0	78.3	7.7	6.9	0.4	89.3	90.3	91.8	6.7	88.3	13.0	13.0	1.5
N52	85.0	77.2	7.8	7.2	0.5	88.6	90.4	92.1	6.4	88.6	12.0	10.5	1.7
N53	85.3	77.2	8.0	6.9	0.4	88.7	89.7	90.9	6.7	87.3	14.5	14.5	1.2
Avg.	85.5	78.0	7.5	7.0	0.5	89.0	90.6	92.1	6.6	88.7	11.9	11.3	1.5
Std Dv	0.4	0.9	0.6	0.2	0.0	0.5	1.0	1.2	0.3	1.0	2.1	2.5	0.2
90% CI	0.4	0.8	0.6	0.2	0.0	0.4	1.0	1.1	0.3	1.0	2.0	2.4	0.2
500 FT. FLYOVER -- TARGET IAS 86.0 MPH													
N54	84.0	73.9	10.2	6.7	0.3	87.1	86.0	86.9	6.8	81.7	33.0	32.0	0.9
N55	83.5	75.9	7.6	6.3	0.4	86.6	88.0	89.0	6.4	83.2	16.0	15.5	1.0
N56	83.4	74.1	9.3	6.8	0.4	86.5	86.0	87.2	7.1	82.3	23.5	20.5	1.1
Avg.	83.6	74.6	9.0	6.6	0.3	86.7	86.7	87.7	6.7	82.4	24.2	22.7	1.0
Std Dv	0.3	1.1	1.3	0.3	0.0	0.3	1.2	1.1	0.4	0.7	8.5	8.5	0.1
90% CI	0.6	1.9	2.2	0.4	0.0	0.6	1.9	1.9	0.6	1.3	14.4	14.3	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-5.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 5 CENTERLINE - 188 M. EAST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
500 FT. FLYOVER -- TARGET IAS 130.5 MPH													
A1	84.5	77.0	7.5	6.8	0.4	88.4	89.7	91.2	6.7	87.1	13.0	12.0	1.5
A2	85.2	78.3	6.9	6.3	0.4	89.0	90.3	91.9	6.6	87.6	12.5	12.0	1.6
A3	85.1	77.9	7.2	6.7	0.4	89.0	90.6	92.1	6.5	87.9	12.0	11.5	1.7
A4	85.6	78.4	7.2	6.3	0.4	89.3	90.6	92.2	6.5	87.4	13.5	12.5	1.6
A5	84.6	77.2	7.3	6.5	0.4	88.4	89.8	91.3	6.4	88.1	13.5	12.5	1.7
A6	85.1	77.5	7.6	6.6	0.4	88.8	89.4	91.1	6.8	86.9	14.0	13.5	1.6
Avg.	85.0	77.7	7.3	6.5	0.4	88.8	90.1	91.6	6.6	87.5	13.1	12.3	1.6
Std Dv	0.4	0.6	0.3	0.2	0.0	0.4	0.5	0.5	0.2	0.5	0.7	0.7	0.1
90% CI	0.3	0.5	0.2	0.2	0.0	0.3	0.4	0.4	0.1	0.4	0.6	0.6	0.1
500 FT. FLYOVER -- TARGET IAS 116 MPH													
B8	84.1	76.2	7.9	6.5	0.4	87.7	88.7	90.0	6.6	83.8	16.0	14.5	1.3
B9	83.7	76.0	7.6	6.6	0.4	87.2	88.6	90.1	6.4	84.0	14.5	13.0	1.6
B10	83.3	75.6	7.7	6.6	0.4	86.9	88.4	89.8	6.3	83.5	14.5	13.5	1.4
B11	83.0	75.3	7.6	6.6	0.4	86.8	88.1	89.3	6.7	84.2	14.5	13.0	1.4
B12	83.7	74.8	8.9	7.0	0.4	87.5	87.6	88.9	6.9	83.4	18.5	18.0	1.2
B13	83.0	74.5	8.5	6.9	0.4	86.6	86.9	88.5	6.8	82.9	17.0	15.5	1.6
Avg.	83.4	75.4	8.0	6.7	0.4	87.1	88.1	89.4	6.6	83.6	15.8	14.6	1.4
Std Dv	0.4	0.7	0.5	0.2	0.0	0.4	0.7	0.7	0.2	0.5	1.7	1.9	0.1
90% CI	0.4	0.5	0.4	0.2	0.0	0.4	0.5	0.5	0.2	0.4	1.4	1.6	0.1
500 FT. FLYOVER -- TARGET IAS 101.5 MPH													
C14	83.3	74.9	8.4	6.7	0.4	86.9	87.8	89.1	6.3	83.6	18.0	17.5	1.4
C15	84.2	76.3	7.9	6.2	0.3	87.9	89.0	90.2	6.1	84.3	19.0	18.0	1.4
C16	83.7	76.0	7.7	6.0	0.3	87.1	88.6	90.1	6.5	84.4	19.5	11.5	1.5
C17	83.9	75.8	8.1	6.8	0.4	87.3	88.3	89.3	6.9	84.1	15.5	14.5	1.4
C18	83.4	75.0	8.4	7.1	0.5	87.0	87.7	89.0	6.8	83.4	15.0	15.0	1.4
Avg.	83.7	75.6	8.1	6.6	0.4	87.3	88.3	89.6	6.5	84.0	17.4	15.3	1.4
Std Dv	0.4	0.6	0.3	0.5	0.1	0.4	0.6	0.6	0.3	0.4	2.0	2.6	0.1
90% CI	0.4	0.6	0.3	0.4	0.1	0.4	0.5	0.6	0.3	0.4	1.9	2.5	0.1

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-5.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 5 CENTERLINE - 188 M. EAST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
1000 FT. FLYOVER -- TARGET IAS 130.5 MPH													
D19	82.0	73.1	9.0	6.9	0.4	85.4	84.9	86.6	6.9	82.9	20.0	18.5	1.7
D20	80.6	70.3	10.3	7.2	0.4	83.9	83.5	85.5	6.8	83.9	26.5	17.5	1.9
D21	82.2	72.7	9.6	6.9	0.4	85.5	84.3	86.1	6.8	81.7	24.5	24.5	1.7
D22	82.0	72.7	9.2	7.0	0.4	85.5	84.2	86.2	7.1	83.3	21.0	20.0	2.1
D23	81.6	72.8	8.8	6.7	0.4	85.0	84.2	86.1	7.0	81.9	20.5	19.0	1.9
D24	81.5	72.9	8.6	6.8	0.4	85.3	84.4	86.1	6.8	83.2	19.0	23.0	2.0
D25	82.1	72.4	9.7	7.1	0.4	85.4	84.4	86.1	6.9	81.4	23.0	22.0	1.7
Avg.	81.7	72.4	9.3	6.9	0.4	85.1	84.3	86.1	6.9	82.6	22.1	20.6	1.9
Std Dv	0.6	0.9	0.6	0.2	0.0	0.6	0.4	0.3	0.1	0.9	2.7	2.6	0.2
90% CI	0.4	0.7	0.4	0.1	0.0	0.4	0.3	0.2	0.1	0.7	2.0	1.9	0.1
TAKEOFF -- TARGET IAS 63 MPH (ICAO)													
E26	85.6	77.2	8.4	6.3	0.3	89.2	89.5	91.4	6.4	83.0	21.0	16.5	1.9
E27	85.8	76.1	9.7	6.8	0.3	89.5	88.8	90.4	7.0	82.6	26.5	20.0	1.9
E28	86.8	78.9	7.9	6.4	0.4	90.4	90.9	92.6	6.3	85.0	17.5	17.0	2.3
E29	86.2	77.6	8.7	6.8	0.4	89.7	90.0	91.7	6.5	83.9	18.5	17.0	1.7
E30	85.9	78.1	7.8	6.2	0.3	89.3	90.0	92.3	6.3	84.0	17.5	13.0	2.3
E31	85.8	78.0	7.8	6.5	0.4	89.6	90.4	91.9	6.4	83.6	16.0	16.5	1.5
E32	86.6	77.9	8.6	6.2	0.3	89.6	89.8	91.4	6.7	83.1	24.0	16.5	2.1
E33	86.5	78.9	7.6	6.4	0.4	90.0	90.5	92.7	6.3	83.8	15.5	14.0	2.2
Avg.	86.1	77.8	8.3	6.5	0.4	89.7	90.0	91.8	6.5	83.6	19.6	16.3	2.0
Std Dv	0.4	0.9	0.7	0.2	0.0	0.4	0.7	0.7	0.2	0.7	3.9	2.1	0.3
90% CI	0.3	0.6	0.5	0.2	0.0	0.2	0.4	0.5	0.2	0.5	2.6	1.4	0.2
APPROACH -- TARGET IAS 63 MPH (ICAO)													
F42		----------		NO DATA		----------							
F43	92.7	85.8	6.9	6.4	0.4	95.8	97.9	98.6	6.8	93.2	12.0	11.5	0.7
F44	93.6	87.3	6.3	6.3	0.4	96.6	98.9	99.6	6.9	94.8	10.0	10.5	0.6
F45	92.8	86.6	6.2	6.5	0.5	96.3	99.0	99.8	7.0	94.7	9.0	8.5	0.8
F46	93.7	87.0	6.7	6.5	0.4	96.4	98.4	99.4	6.8	93.6	11.0	11.0	1.0
F47	92.4	85.9	6.5	6.3	0.4	95.0	98.1	99.2	6.0	94.3	10.5	9.5	1.2
F48	93.4	87.2	6.3	6.4	0.4	95.9	98.6	99.3	6.6	93.9	9.5	10.0	0.7
Avg.	93.1	86.6	6.5	6.4	0.4	96.0	98.5	99.3	6.7	94.1	10.3	10.2	0.8
Std Dv	0.6	0.6	0.3	0.1	0.0	0.6	0.5	0.4	0.4	0.6	1.1	1.1	0.2
90% CI	0.5	0.5	0.2	0.1	0.0	0.5	0.4	0.3	0.3	0.5	0.9	0.9	0.2

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

TABLE NO. A.2-5.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
2/9/84

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 5 CENTERLINE - 188 M. EAST JUNE 7,1983

EV	SEL	ALm	SEL-ALm	K(A)	Q	EPNL	PNLm	PNLTm	K(P)	OASPLm	DUR(A)	DUR(P)	TC
TAKEOFF -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
G38	88.2	80.2	8.0	6.7	0.4	91.9	92.4	94.1	6.6	86.0	15.5	15.0	1.7
G39	87.5	79.7	7.8	6.5	0.4	90.8	91.9	93.4	6.5	85.4	16.0	14.0	1.4
G40	88.3	80.8	7.5	6.5	0.4	91.8	92.5	94.3	6.4	86.0	14.0	15.0	1.8
G41	87.7	79.6	8.0	6.6	0.4	91.2	91.5	93.1	6.9	85.2	16.5	15.0	1.7
Avg.	87.9	80.1	7.8	6.6	0.4	91.4	92.1	93.7	6.6	85.6	15.5	14.7	1.7
Std Dv	0.4	0.5	0.3	0.1	0.0	0.5	0.4	0.6	0.2	0.4	1.1	0.5	0.2
90% CI	0.4	0.6	0.3	0.1	0.0	0.6	0.5	0.7	0.3	0.5	1.3	0.6	0.2
APPROACH -- TARGET IAS 63 MPH STANDARD (SEE TEXT)													
H34		----------		NO DATA		----------							
H35	90.3	81.9	8.4	6.8	0.4	93.1	94.6	95.3	6.5	89.8	17.0	15.5	0.7
H36	91.5	83.7	7.8	7.1	0.5	94.6	95.8	96.6	7.0	92.0	12.5	13.5	0.9
H37	91.2	83.0	8.2	6.7	0.4	94.0	95.6	96.5	6.5	91.2	17.0	14.5	0.9
Avg.	91.1	83.5	7.7	6.7	0.4	94.0	95.9	96.7	6.5	91.6	14.4	13.4	0.8
Std Dv	0.6	1.4	0.9	0.4	0.0	0.7	1.2	1.3	0.4	1.5	3.1	2.4	0.1
90% CI	0.7	1.6	1.1	0.5	0.1	0.8	1.5	1.5	0.5	1.8	3.6	2.8	0.1
500 FT. FLYOVER -- TARGET IAS 145 MPH													
M49		----------		NO DATA		----------							
M50	86.3	79.9	6.4	5.7	0.3	90.1	92.6	94.1	6.2	90.6	13.5	9.0	1.5
M51	86.7	78.8	7.8	6.3	0.3	90.2	91.7	93.2	6.7	90.6	17.5	11.0	1.5
M52	85.6	78.2	7.4	6.6	0.4	89.3	91.5	93.0	6.8	91.0	13.0	8.5	1.5
M53	86.5	78.6	7.9	6.8	0.4	90.0	91.0	92.4	6.7	89.0	14.5	13.5	1.5
Avg.	86.3	78.9	7.4	6.4	0.4	89.9	91.7	93.2	6.6	90.3	14.6	10.5	1.5
Std Dv	0.5	0.7	0.7	0.5	0.1	0.4	0.7	0.7	0.3	0.9	2.0	2.3	0.0
90% CI	0.6	0.9	0.8	0.6	0.1	0.5	0.8	0.8	0.3	1.1	2.4	2.7	0.0
500 FT. FLYOVER -- TARGET IAS 86.0 MPH													
N54		----------		NO DATA		----------							
N55	84.3	75.7	8.6	7.1	0.4	87.3	88.1	89.0	7.0	83.6	16.5	15.0	0.9
N56	84.7	74.6	10.0	7.1	0.4	87.8	87.1	88.0	7.0	84.1	26.0	25.5	1.0
Avg.	84.5	75.1	9.3	7.1	0.4	87.6	87.6	88.5	7.0	83.8	21.2	20.2	0.9
Std Dv	0.3	0.7	1.0	0.0	0.0	0.4	0.7	0.7	0.1	0.4	6.7	7.4	0.1
90% CI	1.3	3.2	4.6	0.1	0.2	1.6	3.3	3.2	0.3	1.6	30.0	33.1	0.3

* - NOISE INDEXES CALCULATED USING MEASURED DATA UNCORRECTED
FOR TEMPERATURE,HUMIDITY,OR AIRCRAFT DEVIATION FROM REF FLIGHT TRACK

APPENDIX B

Direct Read Acoustical Data and Duration Factors for Flight Operations

In addition to the magnetic recording systems, four direct-read, Type-1 noise measurement systems were deployed at selected sites during flight operations. The data acquisition is described in Section 5.6.2.

These direct read systems collected single event data consisting of maximum A-weighted sound level (AL), Sound Exposure Level (SEL), integration time (T), and equivalent sound level (LEQ). The SEL and dBA, as well as the integration time were put into a computer data file and analyzed to determine two figures of merit related to the event duration influence on the SEL energy dose metric. The data reduction is further described in Section 6.2.2; the analysis of these data is discussed in Section 9.4.

This appendix presents direct read data and contains the results of the helicopter noise duration effect analysis for flight operations. The direct read acoustical data for static operations is presented in Appendix D.

Each table within this appendix provides the following information:

Run No.	The test run number
SEL(dB)	Sound Exposure Level, expressed in decibels
AL(dB)	A-Weighted Sound Level, expressed in decibels
T(10-dB)	Integration time
K(A)	Propagation constant describing the change in dBA with distance
Q	Time history "shape factor"
Average	The average of the column
N	Sample size
Std Dev	Standard Deviation
90% C.I.	Ninety percent confidence interval
Mic Site	The centerline mircophone site at which the measurements were taken

HELICOPTER: TWINSTAR

TABLE B.1.1

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
A1	85.8	78.2	NA	NA	NA
A2	86.4	79.2	NA	NA	NA
A3	86.1	79	NA	NA	NA
A4	86.8	79.2	NA	NA	NA
A5	84.8	78.1	NA	NA	NA
A6	86.3	78.1	NA	NA	NA
AVERAGE	86.00	78.60			
N	6	6			
STD.DEV.	0.69	0.55			
90% C.I.	0.57	0.46			

HELICOPTER: TWINSTAR

TABLE B.1.2

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
A1	85.4	78.2	12	6.7	.4
A2	85.8	79	12	6.3	.4
A3	86.1	79.5	11	6.3	.4
A4	86.6	79	12	7	.5
A5	85.3	77.5	12	7.2	.5
A6	86.6	79.7	11.5	6.5	.4
AVERAGE	86.00	78.80	11.80	6.70	.4
N	6	6	6	6	6
STD.DEV.	0.57	0.83	0.42	.38	.04
90% C.I.	0.47	0.69	0.34	.31	.03

HELICOPTER: TWINSTAR TABLE B.1.3

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
A1	85.2	78	12	6.7	.4
A2	86.3	78.7	15	6.5	.4
A3	86	79.6	10	6.4	.4
A4	86.2	79.2	13	6.3	.4
A5	84.4	76.6	13	7	.5
A6	86.1	78.4	11.5	7.3	.5
AVERAGE	85.70	78.40	12.40	6.70	.4
N	6	6	6	6	6
STD.DEV.	0.75	1.06	1.69	.38	.05
90% C.I.	0.62	0.87	1.39	.31	.04

HELICOPTER: TWINSTAR TABLE B.2.1

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 116 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
B7	84.4	77.2	NA	NA	NA
B8	85	76.8	NA	NA	NA
B9	84.7	77.1	NA	NA	NA
B10	84.3	76.2	NA	NA	NA
B11	84.2	76.5	NA	NA	NA
B12	84.8	75.5	NA	NA	NA
B13	84	75.6	NA	NA	NA
AVERAGE	84.50	76.40			
N	7	7			
STD.DEV.	0.36	0.68			
90% C.I.	0.26	0.50			

HELICOPTER: TWINSTAR **TABLE B.2.2**

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 116 MPH

MIC SITE: [illegible]

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
B7	84.7	77.6	12.5	6.5	.4
B8	85.5	77.4	15	6.9	.4
B9	84.8	77	12	7.2	.5
B10	84.7	76.7	15	6.8	.4
B11	84.6	76.8	13	7	.5
B12	85	76.4	18	6.9	.4
B13	83.8	75.9	13	7.1	.5
AVERAGE	84.70	76.80	14.10	6.90	.4
N	7	7	7	7	7
STD.DEV.	0.51	0.58	2.09	.24	.04
90% C.I.	0.37	0.43	1.54	.18	.03

HELICOPTER: TWINSTAR **TABLE B.2.3**

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 116 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
B7	83.8	76.4	12	6.9	.5
B8	85.1	77.1	15.5	6.7	.4
B9	84.5	76.7	12	7.2	.5
B10	84.4	76.1	17	6.7	.4
B11	84.1	76.4	14	6.7	.4
B12	84.2	75.2	18	7.2	.4
B13	83.2	71.6	14	10.1	1
AVERAGE	84.20	75.60	14.60	7.40	.5
N	7	7	7	7	7
STD.DEV.	0.59	1.88	2.32	1.23	.23
90% C.I.	0.44	1.38	1.71	.91	.17

HELICOPTER: TWINSTAR

TABLE B.3.1

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 101.5 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
C14	83.8	75.4	NA	NA	NA
C15	84.9	76.3	NA	NA	NA
C16	84.3	76.5	NA	NA	NA
C17	84.7	76.3	NA	NA	NA
C18	84	75.7	NA	NA	NA
AVERAGE	84.30	76.00			
N	5	5			
STD.DEV.	0.46	0.47			
90% C.I.	0.44	0.45			

HELICOPTER: TWINSTAR

TABLE B.3.2

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 101.5 MPH

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
C14	83.5	75.8	15	6.5	.4
C15	84.5	76.3	14	7.2	.5
C16	84.2	76.4	14	6.8	.4
C17	84.3	75.5	15.5	7.4	.5
C18	84.2	76.2	13	7.2	.5
AVERAGE	84.10	76.00	14.30	7.00	.5
N	5	5	5	5	5
STD.DEV.	0.38	0.38	0.97	.34	.04
90% C.I.	0.36	0.36	0.93	.32	.04

HELICOPTER: TWINSTAR TABLE B.3.3

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 101.5 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
C14	83.5	74.6	15	7.6	.5
C15	84.5	76.1	18	6.7	.4
C16	84.2	75.4	14	7.7	.5
C17	84.3	75.9	15.5	7.1	.5
C18	84.2	75.6	14	7.5	.5
AVERAGE	84.10	75.50	15.30	7.30	.5
N	5	5	5	5	5
STD.DEV.	0.38	0.57	1.64	.4	.07
90% C.I.	0.36	0.54	1.57	.38	.06

HELICOPTER: TWINSTAR TABLE B.4.1

TEST DATE: 6-7-83

OPERATION: 1000 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
D19	82.6	74.1	NA	NA	NA
D20	81.2	71.3	NA	NA	NA
D21	82.8	72.8	NA	NA	NA
D22	82.1	73.4	NA	NA	NA
D23	82	72.9	NA	NA	NA
D24	82	73.3	NA	NA	NA
D25	82.2	72.6	NA	NA	NA
AVERAGE	82.10	72.90			
N	7	7			
STD.DEV.	0.51	0.87			
90% C.I.	0.38	0.64			

HELICOPTER: TWINSTAR **TABLE B.4.2**

TEST DATE: 6-7-83

OPERATION: 1000 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: [illegible]

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
D19	82.1	72.5	21	7.3	.4
D20	81.9	72.3	19.5	7.4	.5
D21	82.1	72.3	24	7.1	.4
D22	81.7	73.1	16	7.1	.5
D23	81.4	72	21	7.1	.4
D24	81.6	72.5	17	7.4	.5
D25	81.8	72	22	7.3	.4
AVERAGE	81.80	72.40	20.10	7.20	.4
N	7	7	7	7	7
STD.DEV.	0.26	0.38	2.81	.14	.03
90% C.I.	0.19	0.28	2.06	.1	.02

HELICOPTER: TWINSTAR **TABLE B.4.3**

TEST DATE: 6-7-83

OPERATION: 1000 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
D19	81.8	72.1	20	7.5	.5
D20	82.3	73.2	16	7.6	.5
D21	82.8	73.8	21	6.8	.4
D22	81.4	72.7	20	6.7	.4
D23	82.1	71.9	24	7.4	.4
D24	81.5	72.9	18.5	6.8	.4
D25	81.8	71.7	24	7.3	.4
AVERAGE	82.00	72.60	20.50	7.10	.4
N	7	7	7	7	7
STD.DEV.	0.49	0.76	2.87	.37	.05
90% C.I.	0.36	0.56	2.11	.27	.04

HELICOPTER: TWINSTAR TABLE B.5.1

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH (ICAO)

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
E26	86.3	77.4	NA	NA	NA
E27	86.2	76.3	NA	NA	NA
E28	87.5	79.3	NA	NA	NA
E29	87	78	NA	NA	NA
E30	86.7	78.3	NA	NA	NA
E31	86.6	78.5	NA	NA	NA
E32	87.1	78.7	NA	NA	NA
E33	87.5	79.4	NA	NA	NA
AVERAGE	86.90	78.20			
N	8	8			
STD.DEV.	0.50	1.02			
90% C.I.	0.33	0.68			

HELICOPTER: TWINSTAR TABLE B.5.2

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH (ICAO)

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
E26	84.8	74.3	NA	NA	NA
E27	84.4	74.3	24	7.3	.4
E28	85.8	75.4	26	7.3	.4
E29	84.6	74.8	21	7.4	.5
E30	83.9	72.2	27	8.2	.5
E31	84.5	74.4	22	7.5	.5
E32	84.8	74.9	24	7.2	.4
E33	85.2	74.8	24	7.5	.5
AVERAGE	84.80	74.40	24.00	7.50	.5
N	8	8	7	7	7
STD.DEV.	0.57	0.96	2.08	.32	.05
90% C.I.	0.38	0.64	1.53	.24	.03

HELICOPTER: TWINSTAR

TABLE B.5.3

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH (ICAO)

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
E26	83.4	72.4	32	7.3	.4
E27	83.3	72.5	30	7.3	.4
E28	84.5	73.7	29.5	7.3	.4
E29	83.5	72.2	27	7.9	.5
E30	83.2	72.4	28	7.5	.4
E31	83.3	73.1	27	7.1	.4
E32	83.8	72.8	33	7.2	.4
E33	83.7	73.4	24	7.5	.5
AVERAGE	83.60	72.80	28.80	7.40	.4
N	8	8	8	8	8
STD.DEV.	0.42	0.54	2.93	.23	.04
90% C.I.	0.28	0.36	1.96	.15	.03

HELICOPTER: TWINSTAR TABLE B.6.1

TEST DATE: 6-7-83

OPERATION: APPROACH--TARGET IAS 63 MPH (ICAO)

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
F42	93.5	86.6	NA	NA	NA
F43	92.7	85.8	NA	NA	NA
F44	93.9	87.6	NA	NA	NA
F45	92.7	86.6	NA	NA	NA
F46	93.9	87.3	NA	NA	NA
F47	92.3	85.8	NA	NA	NA
F48	93.7	87.8	NA	NA	NA
AVERAGE	93.20	86.80			
N	7	7			
STD.DEV.	0.66	0.81			
90% C.I.	0.49	0.60			

HELICOPTER: TWINSTAR TABLE B.6.2

TEST DATE: 6-7-83

OPERATION: APPROACH--TARGET IAS 63 MPH (ICAO)

MIC SITE: 1

RUN ..	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
F42	91.9	83.8	12	7.5	.5
F43	92.8	84.9	13	7.1	.5
F44	91.9	85	10.3	6.8	.5
F45	95.9	93.2	12	2.5	.2
F46	97.8	NA	11	NA	NA
F47	94.3	87.6	11	6.4	.4
F48	91.9	NA	9	NA	NA
AVERAGE	93.80	86.90	11.20	6.10	.4
N	7	5	7	5	5
STD.DEV.	2.33	3.79	1.31	2.03	.15
90% C.I.	1.71	3.61	0.96	1.94	.14

HELICOPTER: TWINSTAR TABLE B.6.3

TEST DATE: 6-7-83

OPERATION: APPROACH--TARGET IAS 63 MPH (ICAO)

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
F42	82.4	84.2	13	-1.5	.1
F43	82.9	82.9	16	0	.1
F44	81.1	81.1	18	0	.1
F45	84.1	84.1	14	0	.1
F46	85.3	85.3	12	0	.1
F47	85.9	85.9	10	0	.1
F48	84.1	84.1	13	0	.1
AVERAGE	83.70	83.90	13.70	-0.10	..
N	7	7	7	7	7
STD.DEV.	1.67	1.58	2.63	.61	.02
90% C.I.	1.23	1.16	1.93	.45	.01

HELICOPTER: TWINSTAR TABLE B.7.1

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH STANDARD

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
G38	88.1	80.2	NA	NA	NA
G39	87.4	80	NA	NA	NA
G40	88.6	81.1	NA	NA	NA
G41	87.7	79.8	NA	NA	NA
AVERAGE	88.00	80.30			
N	4	4			
STD.DEV.	0.52	0.57			
90% C.I.	0.61	0.68			

HELICOPTER: TWINSTAR **TABLE B.7.2**

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH STANDARD

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
G38	86.4	77.1	21	7	.4
G39	85.3	76.3	17	7.3	.5
G40	86.2	77.8	16	7	.4
G41	85.6	76.2	21	7.1	.4
AVERAGE	85.90	76.90	18.80	7.10	.4
N	4	4	4	4	4
STD.DEV.	0.51	0.75	2.63	.15	.03
90% C.I.	0.60	0.88	3.09	.17	.03

HELICOPTER: TWINSTAR **TABLE B.7.3**

TEST DATE: 6-7-83

OPERATION: TAKEOFF--TARGET IAS 63 MPH STANDARD

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
G38	85.9	76.6	19.5	7.2	.4
G39	85.2	75.7	19	7.4	.5
G40	85.8	76.1	16	8.1	.6
G41	85.3	75	24	7.5	.5
AVERAGE	85.60	75.90	19.60	7.50	.5
N	4	4	4	4	4
STD.DEV.	0.35	0.68	3.30	.36	.06
90% C.I.	0.41	0.80	3.58	.43	.08

HELICOPTER: TWINSTAR   TABLE B.8.1

TEST DATE: 6-7-83

OPERATION: APPROAH--TARGET IAS 63 MPH STANDARD

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
H34	87.2	81.1	NA	NA	NA
H35	92.3	85.9	NA	NA	NA
H36	90.2	82	NA	NA	NA
H37	91.8	83.6	NA	NA	NA
AVERAGE	90.40	83.20			
N	4	4			
STD.DEV.	2.30	2.10			
90% C.I.	2.70	2.48			

HELICOPTER: TWINSTAR   TABLE B.8.2

TEST DATE: 6-7-83

OPERATION: APPROAH--TARGET IAS 63 MPH STANDARD

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
H34	90.8	82.6	17	6.7	.4
H35	89.4	79.7	16.4	8	.6
H36	NA	NA	7	NA	NA
H37	90.1	82.2	13	7.1	.5
AVERAGE	90.10	81.50	13.40	7.20	.5
N	3	3	4	3	3
STD.DEV.	0.70	1.57	4.59	.67	.09
90% C.I.	1.18	2.65	5.40	1.14	.15

HELICOPTER: TWINSTAR TABLE B.8.3

TEST DATE: 6-7-83

OPERATION: APPROAH--TARGET IAS 63 MPH STANDARD

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
H34	91.6	84.4	15	6.1	.4
H35	90.2	80.5	22.2	7.2	.4
H36	89.9	80.6	23	6.8	.4
H37	90.2	82.3	13	7.1	.5
AVERAGE	90.50	82.00	18.30	6.80	.4
N	4	4	4	4	4
STD.DEV.	0.76	1.83	5.04	.49	.05
90% C.I.	0.90	2.15	5.93	.57	.06

HELICOPTER: TWINSTAR **TABLE B.9.1**

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 145 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
M49	86.5	79.7	NA	NA	NA
M50	86.8	80.5	NA	NA	NA
M51	86.[illegible]	79.7	NA	NA	NA
M52	86.1	79	NA	NA	NA
M53	86.5	78.7	NA	NA	NA
AVERAGE	86.50	79.30			
N	5	5			
STD.DEV.	0.25	0.78			
90% C.I.	0.24	0.74			

HELICOPTER: TWINSTAR **TABLE B.9.2**

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 145 MPH

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
M49	86.3	78.3	12.5	7.3	.5
M50	86	80.3	9	6.3	.5
M51	86.3	78.9	11	7.1	.5
M52	85.8	79	10	6.8	.5
M53	86.3	79.4	12	6.4	.4
AVERAGE	86.10	79.20	10.70	6.80	.5
N	5	5	5	5	5
STD.DEV.	0.23	0.74	1.79	.43	.04
90% C.I.	0.22	0.71	1.71	.41	.04

HELICOPTER: TWINSTAR **TABLE B.9.3**

TEST DATE: 6-7-83

OPERATION: 500 FT.LFO--TARGET IAS 145 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
M49	86.6	79.8	10	6.8	.5
M50	86.3	80	9	6.6	.5
M51	86.9	79.3	13	6.8	.4
M52	85.8	78.7	11	6.8	.5
M53	86	78.2	14	6.8	.4
AVERAGE	86.30	79.20	11.40	6.80	.5
N	5	5	5	5	5
STD.DEV.	0.44	0.75	2.07	.09	.02
90% C.I.	0.42	0.72	1.98	.09	.02

HELICOPTER: TWINSTAR **TABLE B.10.1**

TEST DATE: 6-7-83

OPERATION: 750 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 5

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
N54	84.9	75	NA	NA	NA
N55	83.9	76	NA	NA	NA
N56	84.5	74.7	NA	NA	NA
AVERAGE	84.40	75.20			
N	3	3			
STD.DEV.	0.50	0.68			
90% C.I.	0.85	1.15			

HELICOPTER: TWINSTAR

TABLE B.10.2

TEST DATE: 6-7-83

OPERATION: 750 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 4

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
N54	84.7	74.8	21	7.5	.5
N55	84.1	76.3	NA	NA	NA
N56	84.2	74.7	21	7.2	.4
AVERAGE	84.30	75.30	21.00	7.30	.4
N	3	3	2	2	2
STD.DEV.	0.32	0.90	0.00	.21	.04
90% C.I.	0.54	1.51	0.00	.96	.16

HELICOPTER: TWINSTAR

TABLE B.10.3

TEST DATE: 6-7-83

OPERATION: 750 FT.LFO--TARGET IAS 130.5 MPH

MIC SITE: 1

RUN NO.	SEL(DB)	AL(DB)	T(10-DB)	K(A)	Q
N54	83.6	74.4	19	7.2	.4
N55	84.1	75.9	17	6.7	.4
N56	84.1	74.7	20	7.2	.4
AVERAGE	83.90	75.00	18.70	7.00	.4
N	3	3	3	3	3
STD.DEV.	0.29	0.79	1.53	.32	.03
90% C.I.	0.49	1.34	2.58	.53	.05

APPENDIX C

Magnetic Recording Acoustical Data for Static Operations

This appendix contains time averaged, A-weighted sound level data along with time averaged, one-third octave sound pressure level information for eight different directivity emission angles. These data were acquired June 6 using the TSC magnetic recording system discussed in Section 5.6.1.

Thirty-two seconds of corrected raw spectral data (64 contiguous 1/2 second data records) have been energy averaged to produce the data tabulated in this appendix. The spectral data presented are "As Measured" for the given emission angles established relative to each microphone location. Also included in the tables are the 360 degree (eight emission angle) average levels, calculated by both arithmetic and energy averaging. The data reduction is further described in Section 6.1. Figure 6.1 (previously shown) provides the reader with a quick reference to the emission angle convention.

The data contained in these tables have been used in analyses presented in Sections 9.2 and 9.7. The reader may cross reference the magnetic recording data of this appendix with direct read static data presented in Appendix D.

APPENDIX C

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The data contained in these tables have been used in analyses presented in Sections 9.2 and 9.7. The reader may cross reference the magnetic recording data of this appendix with direct read static data presented in Appendix D.

Appendix C

"As Measured" 1/3 Octave Noise Data--Static Test are presented.

The key to the table numbering system is as follows:

Table No. C. 1-1H. 1

Appendix No.

Helicopter No. & Microphone Location

Page No. of Group

Table No.	C.1-X.X	Aerospatiale	SA-365N (Dauphin)
	C.2-X.X	Aerospatiale	SA-355F (Twinstar)
	C.3-X.X	Aerospatiale	AS-350D (Astar)
	C.4-X.X	Sikorsky	S-76 (Spirit)
	C.5-X.X	Bell	222
	C.6-X.X	Hughes	500D
	C.7-X.X	Boeing Vertol	CH-470D (Shinook)

Microphone No.	1H	(soft)	150 m northwest
	2	(soft)	150 m west
	4H	(soft)	300 m west
	5H	(hard)	150 m north

Page No.	1	Hover-in-Ground-Effect
	2	Flight Idle
	3	Ground Idle
	4	Hover-Out-of-Ground-Effect

TABLE NO. C.2-1H.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 1H (SOFT) - 150 M. NW JUNE 7,1983

HOVER-IN-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	49.5	47.0	47.0	49.9	50.2	51.1	50.2	52.8	50.1	5.4	49.7	2.0
15	55.3	56.6	55.3	55.8	56.9	55.8	57.5	56.2	56.2	16.8	56.2	0.8
16	68.5	69.9	68.5	68.7	69.7	68.3	70.5	69.1	69.2	34.6	69.1	0.8
17	58.2	58.6	56.7	56.6	57.0	59.8	59.4	58.3	58.2	28.0	58.1	1.2
18	68.7	69.6	64.7	71.1	74.0	69.3	68.6	69.3	70.1	43.9	69.4	2.6
19	62.1	63.6	61.0	63.8	65.7	65.6	63.6	63.1	63.8	41.3	63.6	1.6
20	57.6	60.0	60.2	61.0	62.9	64.7	62.1	59.7	61.5	42.4	61.0	2.2
21	65.5	65.5	65.3	66.3	71.5	67.9	72.3	71.2	69.1	53.0	68.2	3.0
22	62.3	65.9	63.0	66.5	68.5	68.6	67.6	66.7	66.6	53.2	66.1	2.4
23	61.3	65.9	63.7	67.0	70.0	69.1	69.8	68.0	67.7	56.8	66.8	3.1
24	57.5	65.7	63.3	67.3	70.0	67.1	67.7	65.2	66.5	57.9	65.5	3.8
25	53.1	61.1	61.5	66.0	68.6	64.8	63.4	59.6	64.0	57.4	62.3	4.7
26	44.2	51.9	55.9	60.0	61.1	60.5	55.1	50.7	57.4	52.6	54.9	5.8
27	38.2	44.8	47.9	49.4	51.1	52.2	46.8	46.3	48.5	45.3	47.1	4.4
28	43.9	48.6	43.6	43.0	44.1	48.8	51.1	50.9	47.9	46.0	46.7	3.4
29	48.7	53.4	44.1	44.3	44.7	51.6	55.0	54.4	51.4	50.6	49.5	4.7
30	51.4	54.6	45.1	45.9	46.6	53.8	56.5	56.3	53.2	53.2	51.3	4.8
31	52.3	55.9	44.3	46.5	46.9	54.3	57.5	57.2	54.1	54.7	51.9	5.3
32	52.2	57.1	42.1	45.2	45.7	52.8	58.0	57.6	54.3	55.3	51.3	6.3
33	51.8	56.9	40.6	43.8	44.4	52.2	56.7	56.8	53.6	54.8	50.4	6.6
34	47.7	54.4	39.0	42.3	42.6	50.2	53.9	53.5	50.8	52.1	47.9	6.0
35	47.9	50.3	38.2	41.6	40.6	49.2	50.5	50.7	48.1	49.3	46.1	5.1
36	48.1	49.3	36.0	39.1	37.9	46.3	48.0	49.8	46.6	47.6	44.3	5.7
37	46.1	48.2	35.7	37.8	35.9	46.0	49.3	49.2	46.1	46.6	43.5	6.0
38	41.8	43.7	32.1	34.6	33.3	42.1	43.4	44.2	41.4	41.3	39.4	5.1
39	38.4	40.0	30.4	31.2	30.2	38.4	39.0	40.7	37.7	36.6	36.0	4.6
40	32.8	33.7	25.2	-	-	33.0	33.6	35.5	33.2	30.7	32.3	3.6
AL	62.0	66.5	61.2	64.8	67.3	66.6	68.1	67.2	66.0	66.0	65.5	2.6
OASPL	74.2	76.3	74.0	76.9	79.6	77.5	78.3	77.2	77.1	-	76.7	1.9
PNL	75.4	79.8	73.9	77.4	79.6	80.2	81.3	80.3	79.3	-	78.5	2.6
PNLT	76.9	81.2	74.9	79.2	81.8	81.3	82.6	81.7	80.8	-	79.9	2.7

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-1H.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 1H (SOFT) - 150 M. NW JUNE 7,1983

FLIGHT IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	43.3	43.4	44.2	43.9	46.4	43.8	42.2	43.2	44.0	-0.7	43.8	1.2
15	53.5	54.1	53.8	52.2	53.9	53.6	49.7	53.3	53.2	13.8	53.0	1.5
16	65.7	66.3	65.7	63.4	65.4	65.5	61.9	65.4	65.1	30.5	64.9	1.5
17	56.2	55.1	57.8	53.3	55.5	55.9	50.6	56.7	55.6	25.4	55.1	2.2
18	67.4	63.5	66.1	68.7	70.6	65.8	56.6	64.9	66.8	40.6	65.4	4.2
19	57.9	57.8	57.8	60.0	59.8	58.2	53.3	59.6	58.4	35.9	58.0	2.1
20	53.9	55.1	56.5	55.8	57.1	58.3	55.4	57.5	56.4	37.3	56.2	1.4
21	61.2	61.2	68.2	63.4	66.3	64.8	65.1	65.5	65.0	48.9	64.5	2.4
22	57.6	58.2	60.9	59.2	59.5	62.4	64.1	61.3	60.9	47.5	60.4	2.2
23	60.4	59.5	63.7	65.0	63.6	64.1	64.1	63.0	63.3	52.4	62.9	1.9
24	59.6	60.3	62.4	65.3	64.1	65.5	63.4	61.7	63.2	54.6	62.8	2.2
25	56.2	58.2	59.9	62.8	61.3	64.1	62.0	60.3	61.2	54.6	60.6	2.5
26	50.1	54.5	54.3	57.4	55.1	59.2	57.4	55.5	56.1	51.3	55.4	2.7
27	40.7	46.4	45.9	49.3	47.1	50.2	46.9	45.7	47.2	44.0	46.5	2.8
28	32.1	37.2	37.6	41.2	37.6	41.0	36.5	35.8	38.2	36.3	37.4	2.9
29	33.9	38.5	38.4	42.0	38.0	42.5	37.7	38.9	39.4	38.6	38.7	2.7
30	35.5	38.0	38.7	44.3	38.5	44.3	39.4	41.8	41.1	41.1	40.1	3.1
31	34.5	37.9	39.4	42.8	38.4	42.9	36.8	40.4	39.9	40.5	39.1	2.9
32	34.1	36.8	38.0	43.0	37.5	41.8	37.0	40.1	39.4	40.4	38.5	2.9
33	33.0	36.5	36.4	41.4	36.7	40.4	35.3	37.8	37.9	39.1	37.2	2.7
34	32.4	34.7	34.8	39.7	36.1	38.1	34.7	36.8	36.4	37.7	35.9	2.3
35	32.4	33.1	33.7	38.8	34.7	36.8	33.2	35.8	35.3	36.5	34.8	2.2
36	32.4	31.5	32.8	36.8	33.4	35.0	30.8	34.8	33.9	34.9	33.4	2.0
37	30.4	30.4	32.7	35.8	31.0	33.8	-	32.8	32.8	33.3	32.4	2.0
38	26.9	28.2	29.3	32.3	28.0	30.2	-	29.5	29.5	29.4	29.2	1.8
39	26.3	27.6	26.8	-	25.5	-	-	26.8	26.7	25.6	26.6	0.8
40	29.2	27.5	25.3	-	-	-	-	30.3	28.5	26.0	28.1	2.2
AL	56.6	57.8	60.2	62.1	60.8	62.8	61.2	59.9	60.6	60.6	60.2	2.1
OASPL	71.8	71.1	73.6	73.7	74.6	73.8	71.9	72.7	73.1	-	72.9	1.2
PNL	69.0	70.0	72.4	74.7	73.1	74.8	72.1	72.1	72.8	-	72.3	2.0
PNLT	70.7	71.2	74.0	76.7	75.3	76.3	72.9	73.2	74.4	-	73.8	2.2

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-1H.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 1H (SOFT) - 150 M. NW JUNE 7,1983

GROUND IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	-	41.9	-	41.8	-	43.3	-	44.4	43.0	-1.7	42.8	1.2
15	-	42.2	-	46.0	-	44.5	-	43.4	44.3	4.9	44.0	1.6
16	-	50.0	-	52.8	-	49.7	-	46.7	50.3	15.7	49.8	2.5
17	-	41.8	-	42.4	-	44.6	-	42.6	43.0	12.8	42.8	1.2
18	-	44.3	-	44.3	-	47.6	-	45.7	45.7	19.5	45.5	1.6
19	-	48.7	-	50.9	-	49.0	-	50.8	50.0	27.5	49.8	1.2
20	-	46.0	-	46.8	-	49.4	-	49.3	48.1	29.0	47.9	1.7
21	-	51.9	-	49.8	-	49.2	-	51.9	50.9	34.8	50.7	1.4
22	-	53.6	-	49.3	-	50.9	-	53.2	52.1	38.7	51.7	2.0
23	-	55.1	-	54.4	-	54.0	-	54.5	54.5	43.6	54.5	0.5
24	-	53.7	-	55.0	-	56.4	-	53.2	54.8	46.2	54.6	1.4
25	-	50.3	-	52.8	-	54.1	-	48.2	51.9	45.3	51.3	2.6
26	-	45.2	-	45.8	-	44.5	-	41.6	44.5	39.7	44.3	1.9
27	-	36.0	-	36.2	-	36.6	-	32.8	35.6	32.4	35.4	1.8
28	-	26.3	-	30.8	-	29.5	-	26.1	28.6	26.7	28.2	2.3
29	-	30.5	-	30.8	-	28.7	-	26.8	29.5	28.7	29.2	1.8
30	-	29.8	-	29.7	-	28.4	-	27.1	28.9	28.9	28.7	1.3
31	-	28.1	-	27.6	-	28.8	-	26.3	27.8	28.4	27.7	1.1
32	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-
AL	-	50.9	-	51.3	-	52.3	-	50.2	51.0	51.0	51.2	0.9
OASPL	-	61.4	-	61.7	-	62.0	-	61.2	61.6	-	61.6	0.4
PNL	-	62.6	-	61.9	-	64.0	-	62.4	61.3	-	62.7	0.9
PNLT	-	64.1	-	62.8	-	64.4	-	64.4	61.8	-	63.9	0.8

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-1H.4

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 1H (SOFT) - 150 M. NW JUNE 7,1983

HOVER-OUT-OF-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	50.1	49.9	48.4	52.7	54.0	52.4	51.5	52.8	51.8	7.1	51.5	1.9
15	55.5	57.0	56.1	57.6	58.1	57.3	56.0	56.3	56.8	17.4	56.7	0.9
16	68.8	70.3	69.3	70.0	70.5	69.7	68.8	69.3	69.6	35.0	69.6	0.6
17	57.1	58.8	57.6	58.4	57.7	60.1	58.1	57.3	58.2	28.0	58.1	1.0
18	69.7	71.3	66.7	72.6	74.5	70.6	67.5	67.8	70.8	44.6	70.1	2.7
19	62.0	64.3	61.3	65.3	67.8	66.1	63.3	61.6	64.5	42.0	64.0	2.3
20	56.5	59.7	60.4	63.7	66.8	66.3	62.3	56.5	63.0	43.9	61.5	4.0
21	67.4	64.2	65.3	67.5	73.2	71.0	70.2	69.6	69.4	53.3	68.5	3.0
22	62.0	63.6	62.7	67.0	71.5	72.0	65.0	63.6	67.6	54.2	65.9	3.9
23	63.2	64.5	63.2	67.3	73.0	72.5	67.9	64.1	68.7	57.8	67.0	4.0
24	57.8	65.5	63.3	67.1	71.5	71.7	65.7	60.2	67.5	58.9	65.3	4.9
25	55.7	63.2	61.3	64.4	68.9	68.2	62.2	56.5	64.6	58.0	62.5	4.8
26	51.7	56.8	55.5	58.1	62.4	63.4	56.3	50.0	58.8	54.0	56.8	4.6
27	49.1	53.6	49.6	60.4	64.5	66.2	55.3	50.5	60.5	57.3	56.1	6.8
28	52.9	58.6	55.0	63.7	68.5	69.6	59.4	54.6	64.2	62.3	60.3	6.4
29	56.9	62.9	57.9	67.6	70.9	72.1	62.5	58.0	67.0	66.2	63.6	6.0
30	58.5	64.9	58.9	68.2	72.7	73.7	63.1	59.2	68.5	68.5	64.9	6.1
31	57.9	65.2	59.8	66.6	71.3	72.2	62.9	58.4	67.2	67.8	64.3	5.5
32	56.6	64.4	59.1	62.0	66.7	66.8	62.3	58.0	63.4	64.4	62.0	3.9
33	55.1	61.9	57.9	54.5	61.6	60.9	59.1	53.9	59.1	60.3	58.1	3.3
34	52.9	58.1	55.9	56.9	60.5	62.5	55.9	49.8	58.0	59.3	56.6	4.0
35	52.7	55.5	54.0	55.9	59.9	61.1	53.1	50.2	56.7	57.9	55.3	3.7
36	50.5	52.6	50.6	49.6	55.4	55.5	50.0	48.9	52.4	53.4	51.6	2.6
37	50.1	50.6	50.4	47.0	51.6	53.2	50.4	49.0	50.6	51.1	50.3	1.8
38	46.0	46.8	46.2	41.7	47.8	48.3	45.3	44.7	46.2	46.1	45.8	2.1
39	42.2	42.2	41.3	-	43.1	43.8	40.8	40.9	42.2	41.1	42.0	1.1
40	36.3	36.6	34.9	-	37.1	37.4	35.0	35.5	36.2	33.7	36.1	1.0
AL	66.5	72.5	68.3	74.0	78.4	79.2	71.1	66.9	74.5	74.5	72.1	4.9
OASPL	75.3	77.6	75.2	79.2	82.9	82.6	77.3	75.7	79.2	-	78.2	3.1
PNL	79.3	84.2	80.9	84.2	88.9	89.4	83.1	79.3	85.1	-	83.7	3.9
PNLT	80.9	85.9	82.1	86.0	90.8	90.6	84.3	80.9	86.7	-	85.2	3.9

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-2H.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 2 (SOFT) - 150 M. WEST JUNE 7,1983

HOVER-IN-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	56.0	55.3	54.4	57.3	58.5	56.9	57.7	58.2	57.0	12.3	56.8	1.4
15	62.9	64.1	63.8	64.0	65.7	62.6	65.2	62.1	64.0	24.6	63.8	1.2
16	75.9	77.0	76.3	76.2	78.1	74.6	78.1	74.9	76.6	42.0	76.4	1.3
17	64.4	65.3	63.3	64.9	65.9	64.6	65.7	63.6	64.8	34.6	64.7	0.9
18	74.3	75.8	71.3	78.2	80.1	74.6	75.2	73.4	76.2	50.0	75.4	2.7
19	67.5	70.0	68.6	71.1	72.6	70.7	69.8	67.5	70.0	47.5	69.7	1.8
20	63.1	64.3	66.2	67.4	70.0	67.4	66.7	64.0	66.7	47.6	66.1	2.3
21	70.9	70.5	72.8	72.4	75.1	71.8	76.5	71.9	73.2	57.1	72.7	2.1
22	67.2	70.0	69.3	73.1	72.9	73.4	71.4	69.3	71.3	57.9	70.8	2.2
23	67.0	71.5	72.0	74.1	75.1	74.5	77.1	70.5	73.6	62.7	72.7	3.2
24	62.9	71.0	69.6	73.5	73.6	73.7	70.0	70.0	71.5	62.9	70.5	3.5
25	61.8	71.4	68.7	73.4	73.8	74.1	68.5	67.6	71.3	64.7	69.9	4.2
26	59.1	69.7	66.9	70.3	73.6	69.6	66.0	64.1	69.1	64.3	67.4	4.5
27	56.6	67.0	66.0	66.9	71.9	69.2	65.5	61.6	67.3	64.1	65.6	4.7
28	51.0	65.3	62.8	65.3	69.8	68.2	63.6	56.6	65.4	63.5	62.8	6.2
29	45.3	60.6	57.0	61.4	64.1	60.8	54.9	47.3	59.5	58.7	56.4	6.9
30	49.7	52.8	50.2	53.9	56.4	53.8	54.9	49.9	53.3	53.3	52.7	2.5
31	53.3	51.4	48.7	51.0	55.7	56.2	58.1	53.9	54.5	55.1	53.5	3.1
32	54.6	52.1	49.1	51.7	55.7	57.2	61.7	55.6	56.3	57.3	54.7	3.9
33	56.0	51.2	48.3	49.9	55.3	56.9	60.1	57.0	55.8	57.0	54.3	4.1
34	56.4	50.6	47.6	48.7	54.0	56.8	60.7	57.3	55.9	57.2	54.0	4.6
35	54.7	49.4	45.7	46.9	52.8	55.3	58.4	55.9	54.1	55.3	52.4	4.6
36	50.7	47.7	43.6	44.1	50.4	53.3	54.4	51.3	50.8	51.8	49.4	4.0
37	53.5	47.1	43.3	43.0	49.1	55.1	54.8	52.4	51.8	52.3	49.8	4.9
38	47.9	44.1	40.1	39.9	46.4	49.9	48.6	48.0	46.8	46.7	45.6	3.9
39	45.9	41.6	37.4	37.2	43.6	47.2	44.6	45.0	44.0	42.9	42.8	3.8
40	40.4	37.3	32.9	32.9	39.4	42.3	39.5	40.3	39.1	36.6	38.1	3.5
AL	67.0	72.2	70.4	73.4	75.9	74.6	73.3	69.8	72.8	72.8	72.1	2.9
OASPL	80.3	82.8	81.6	84.2	85.9	83.5	84.2	80.9	83.3	-	82.9	1.9
PNL	81.7	84.5	82.7	85.6	88.2	87.6	87.9	83.6	85.9	-	85.2	2.5
PNLT	83.1	85.9	83.6	87.3	90.0	88.8	89.1	84.9	87.4	-	86.6	2.6

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-2H.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 2 (SOFT) - 150 M. WEST JUNE 7,1983

FLIGHT IDLE

	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
BAND NO.	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	51.3	52.2	52.9	52.2	52.7	52.2	51.6	51.1	52.1	7.4	52.0	0.6
15	61.2	62.4	61.5	61.0	61.4	61.1	60.6	61.4	61.4	22.0	61.3	0.5
16	72.9	73.7	72.9	71.8	72.8	72.5	72.2	73.1	72.8	38.2	72.7	0.6
17	63.0	62.9	64.9	61.1	62.1	62.8	61.4	63.6	62.9	32.7	62.7	1.2
18	75.2	75.6	72.5	78.2	78.0	71.3	73.0	72.7	75.3	49.1	74.6	2.6
19	66.8	67.3	66.0	69.0	68.3	65.8	66.1	67.5	67.2	44.7	67.1	1.1
20	61.2	62.4	63.4	64.6	64.0	65.2	64.6	63.7	63.8	44.7	63.6	1.3
21	68.2	68.3	74.3	75.2	74.9	68.8	71.2	72.7	72.5	56.4	71.7	3.0
22	63.4	65.7	68.0	68.2	67.7	68.3	67.5	66.4	67.1	53.7	66.9	1.7
23	67.7	68.1	71.2	73.9	71.6	71.6	71.5	67.4	70.9	60.0	70.4	2.3
24	65.9	68.3	70.0	73.0	69.7	71.9	70.4	65.8	70.0	61.4	69.4	2.6
25	63.4	68.7	69.3	73.1	67.6	72.3	70.2	65.4	69.7	63.1	68.7	3.3
26	61.6	67.5	67.5	70.6	64.3	70.9	69.4	63.9	68.0	63.2	67.0	3.4
27	60.0	66.1	65.7	69.6	62.3	68.9	68.1	62.7	66.5	63.3	65.4	3.5
28	55.3	61.0	59.9	65.9	57.3	63.4	63.9	58.6	61.9	60.0	60.7	3.6
29	47.4	54.2	48.5	55.6	50.0	56.3	58.3	52.0	54.2	53.4	52.8	3.9
30	41.4	43.4	44.6	47.6	44.6	52.3	51.0	44.1	47.7	47.7	46.1	3.8
31	37.5	42.4	46.8	45.1	40.1	47.9	45.6	43.0	44.6	45.2	43.5	3.5
32	38.5	42.5	47.5	44.8	41.7	48.0	46.4	44.5	45.1	46.1	44.2	3.2
33	38.1	41.9	46.3	44.2	41.6	47.9	45.5	43.2	44.5	45.7	43.6	3.1
34	38.3	41.8	45.5	43.8	41.2	47.7	45.6	42.5	44.1	45.4	43.3	3.0
35	38.5	41.2	44.4	42.2	39.6	45.9	43.7	41.4	42.7	43.9	42.1	2.5
36	37.8	40.7	43.7	39.6	38.3	43.4	42.0	40.5	41.2	42.2	40.7	2.2
37	37.1	40.8	43.1	38.0	37.0	42.5	41.2	40.0	40.5	41.0	40.0	2.4
38	34.2	36.8	39.8	34.5	34.0	39.0	37.4	36.9	37.1	37.0	36.6	2.2
39	32.1	34.5	36.6	31.2	30.9	35.2	33.4	34.6	34.0	32.9	33.6	2.0
40	39.7	41.8	37.3	27.5	26.8	30.8	30.7	39.1	37.1	34.6	34.2	5.9
AL	65.0	69.3	70.0	73.4	68.6	72.5	71.5	67.0	70.4	70.4	69.7	2.8
OASPL	79.3	80.5	80.9	83.5	82.2	81.0	80.8	79.6	81.2	-	81.0	1.4
PNL	77.5	80.8	81.9	84.4	81.1	83.7	82.7	79.5	81.9	-	81.4	2.3
PNLT	79.2	82.5	83.3	86.6	83.2	84.9	84.3	80.7	83.6	-	83.1	2.3

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-2H.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

DOT/TSC
4/24/84

SITE: 2 (SOFT) - 150 M. WEST JUNE 7,1983

GROUND IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	45.6	--	48.1	--	49.2	--	48.0	--	47.9	3.2	47.7	1.5
15	48.4	--	52.2	--	50.8	--	49.6	--	50.5	11.1	50.2	1.6
16	60.8	--	57.9	--	61.5	--	55.6	--	59.5	24.9	58.9	2.7
17	49.6	--	50.4	--	48.6	--	49.2	--	49.5	19.3	49.4	0.8
18	49.3	--	52.8	--	50.5	--	53.6	--	51.9	25.7	51.6	2.0
19	55.1	--	60.2	--	53.2	--	58.5	--	57.6	35.1	56.7	3.2
20	52.9	--	56.3	--	53.0	--	56.6	--	55.0	35.9	54.7	2.0
21	52.1	--	59.4	--	51.8	--	59.3	--	57.1	41.0	55.6	4.3
22	53.9	--	60.0	--	55.1	--	59.9	--	58.0	44.6	57.2	3.2
23	54.9	--	59.6	--	59.6	--	58.7	--	58.6	47.7	58.2	2.2
24	55.7	--	60.2	--	63.6	--	58.2	--	60.4	51.8	59.4	3.3
25	52.0	--	57.8	--	60.2	--	56.0	--	57.4	50.8	56.5	3.5
26	48.1	--	54.6	--	54.3	--	53.6	--	53.3	48.5	52.6	3.1
27	48.1	--	54.5	--	53.8	--	54.2	--	53.3	50.1	52.6	3.0
28	42.8	--	48.5	--	48.3	--	49.5	--	47.9	46.0	47.3	3.0
29	33.7	--	34.6	--	37.9	--	42.3	--	38.5	37.7	37.1	3.9
30	29.4	--	29.7	--	33.8	--	34.5	--	32.4	32.4	31.8	2.7
31	27.1	--	31.4	--	33.3	--	31.3	--	31.3	31.9	30.8	2.6
32	31.0	--	31.9	--	34.2	--	31.3	--	32.3	33.3	32.1	1.4
33	32.1	--	33.0	--	31.8	--	31.7	--	32.2	33.4	32.1	0.6
34	34.8	--	35.5	--	31.2	--	32.9	--	33.9	35.2	33.6	1.9
35	37.3	--	37.0	--	32.1	--	33.7	--	35.5	36.7	35.0	2.5
36	36.7	--	37.4	--	32.1	--	30.7	--	35.1	36.1	34.2	3.3
37	36.8	--	33.9	--	29.1	--	29.7	--	33.5	34.0	32.4	3.6
38	36.7	--	32.9	--	28.1	--	29.6	--	33.1	33.0	31.8	3.8
39	44.5	--	39.8	--	27.5	--	33.8	--	40.1	39.0	36.4	7.4
40	31.7	--	28.2	--	27.3	--	24.1	--	28.7	26.2	27.8	3.1
AL	54.0	--	58.7	--	59.6	--	57.8	--	58.0	58.0	57.5	2.5
OASPL	65.4	--	68.9	--	68.8	--	67.9	--	68.0	--	67.7	1.6
PNL	66.9	--	70.6	--	70.9	--	69.0	--	70.1	--	69.3	1.8
PNLT	68.6	--	72.1	--	71.5	--	70.2	--	71.6	--	70.6	1.6

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-2H.4

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/24/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 2 (SOFT) - 150 M. WEST JUNE 7,1983

HOVER-OUT-OF-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	59.1	56.7	58.0	60.1	61.9	58.6	58.9	60.2	59.4	14.7	59.2	1.6
15	64.4	65.1	65.1	66.0	69.4	65.7	65.0	64.2	65.9	26.5	65.6	1.6
16	77.5	77.7	77.7	78.4	81.9	78.3	78.0	77.0	78.6	44.0	78.3	1.5
17	65.2	66.5	64.3	66.0	69.0	66.7	65.2	64.6	66.2	36.0	65.9	1.5
18	77.5	78.9	75.1	80.4	82.3	77.2	74.0	75.1	78.4	52.2	77.6	2.9
19	70.4	72.1	70.7	72.7	76.7	73.1	69.4	68.2	72.4	49.9	71.7	2.6
20	64.3	66.3	67.1	70.6	75.4	70.8	66.0	65.1	69.9	50.8	68.2	3.8
21	74.6	71.3	75.1	75.1	79.3	73.7	76.4	73.7	75.5	59.4	74.9	2.3
22	69.6	70.6	71.0	73.7	78.1	74.3	71.0	69.7	73.3	59.9	72.2	2.9
23	71.8	72.1	72.7	74.3	80.5	77.0	74.5	70.3	75.4	64.5	74.1	3.3
24	67.4	72.0	71.3	74.7	79.7	76.2	70.6	72.2	74.5	65.9	73.0	3.8
25	68.4	71.9	70.3	75.4	79.8	76.7	69.6	70.7	74.6	68.0	72.8	4.0
26	67.3	70.3	68.8	74.1	78.2	74.6	68.7	68.4	73.0	68.2	71.3	3.9
27	64.6	68.5	66.1	70.7	75.9	72.8	67.3	68.2	70.8	67.6	69.3	3.7
28	60.4	65.4	61.2	65.4	71.4	70.2	65.2	65.8	67.1	65.2	65.6	3.8
29	56.5	62.6	63.3	67.5	72.5	64.8	61.5	62.3	66.3	65.5	63.9	4.7
30	61.1	62.2	67.1	72.1	75.4	69.1	61.2	63.2	69.5	69.5	66.4	5.4
31	62.8	65.9	67.2	72.4	74.0	70.2	63.9	65.0	69.4	70.0	67.7	4.1
32	60.9	66.7	63.9	68.4	68.7	66.9	66.7	65.2	66.5	67.5	65.9	2.6
33	58.3	65.3	58.6	62.8	65.5	63.1	60.3	63.9	63.0	64.2	62.2	2.8
34	56.0	63.9	58.5	62.9	65.1	59.3	57.7	61.6	61.6	62.9	60.6	3.2
35	57.1	60.8	58.3	63.3	62.8	57.7	56.4	59.7	60.2	61.4	59.5	2.6
36	55.0	57.3	54.4	57.7	59.5	55.7	55.1	56.9	56.8	57.8	56.4	1.7
37	54.2	56.3	54.4	56.9	56.7	58.4	55.9	57.3	56.5	57.0	56.3	1.4
38	50.1	52.8	49.8	52.0	52.8	50.8	50.4	52.8	51.6	51.5	51.4	1.3
39	46.5	49.1	45.3	47.7	48.5	46.9	45.9	48.6	47.5	46.4	47.3	1.4
40	41.4	44.6	40.1	42.5	43.2	41.7	40.9	44.3	42.6	40.1	42.3	1.6
AL	72.3	76.2	75.1	79.6	83.0	79.2	74.8	75.3	78.2	78.2	76.9	3.4
OASPL	83.3	84.4	83.7	86.6	90.4	86.4	83.8	83.1	86.0	-	85.2	2.5
PNL	85.7	89.5	87.2	91.3	94.9	91.3	88.0	88.2	90.4	-	89.5	2.9
PNLT	87.3	91.1	88.5	93.2	96.5	93.0	89.5	89.7	91.9	-	91.1	3.0

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-4H.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 4/24/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 4H (SOFT) - 300 M. WEST JUNE 7,1983

HOVER-IN-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	45.4	44.1	43.9	45.8	47.6	45.9	46.1	48.3	46.1	1.4	45.9	1.5
15	53.5	53.8	52.0	52.6	54.9	52.1	55.1	53.1	53.5	14.1	53.4	1.2
16	66.1	66.3	64.7	64.8	67.2	64.0	67.8	65.6	66.0	31.4	65.8	1.3
17	56.3	55.7	52.6	54.3	55.6	54.8	56.7	54.9	55.3	25.1	55.1	1.3
18	65.3	64.4	59.8	67.3	68.7	63.4	64.7	63.1	65.3	39.1	64.6	2.7
19	57.7	58.4	56.2	59.5	60.4	59.5	59.7	57.8	58.8	36.3	58.6	1.4
20	53.7	53.8	55.1	56.5	58.6	57.2	57.3	53.8	56.1	37.0	55.7	1.9
21	62.0	60.5	61.7	61.9	65.3	62.3	67.9	63.0	63.8	47.7	63.1	2.4
22	57.5	58.6	57.2	60.6	61.6	63.5	61.7	59.4	60.5	47.1	60.0	2.[illegible]
23	56.9	59.6	58.4	60.8	62.8	63.7	66.6	59.3	62.1	51.2	61.0	3.2
24	53.4	59.5	56.8	60.4	61.8	62.9	60.4	60.0	60.1	51.5	59.4	3.0
25	50.2	59.5	55.3	59.4	60.9	62.2	57.6	56.1	58.8	52.2	57.6	3.8
26	43.1	55.3	51.2	54.2	59.0	56.5	52.7	49.1	54.5	49.7	52.6	4.9
27	34.0	49.8	46.4	47.7	53.7	50.4	44.6	37.9	48.6	45.4	45.6	6.6
28	35.5	42.4	36.6	37.8	40.9	42.3	40.5	33.5	39.7	37.8	38.7	3.3
29	37.2	40.9	35.4	36.7	37.1	45.7	43.7	35.7	40.8	40.0	39.0	3.9
30	39.4	41.4	36.7	36.5	38.3	46.1	43.8	36.8	41.3	41.3	39.9	3.6
31	41.0	40.6	37.0	36.7	37.6	45.3	43.1	37.7	41.0	41.6	39.9	3.2
32	41.6	39.3	35.3	34.9	35.1	43.0	42.5	38.1	39.8	40.8	38.7	3.4
33	42.4	37.2	33.8	33.1	32.3	40.1	39.4	37.9	38.3	39.5	37.0	3.6
34	44.0	35.9	32.6	31.6	30.7	38.4	38.1	38.1	38.2	39.5	36.2	4.4
35	45.1	33.1	-	-	-	35.3	35.5	37.7	39.8	41.0	37.3	4.6
36	43.9	29.3	-	-	-	-	33.1	36.8	39.1	40.1	35.8	6.2
37	43.0	28.1	-	-	-	-	34.7	38.7	38.9	39.4	36.1	6.3
38	36.6	22.9	-	-	-	-	28.1	32.6	32.6	32.5	30.1	5.9
39	30.4	-	-	-	-	-	22.2	27.7	27.9	26.8	26.8	4.2
40	20.1	-	-	-	-	-	-	-	20.1	17.6	20.1	-
AL	55.9	58.4	55.6	58.5	60.9	61.3	60.4	56.9	59.1	59.1	58.5	2.2
OASPL	70.8	71.4	69.4	72.2	74.1	72.4	74.1	70.9	72.2	-	71.9	1.6
PNL	70.3	70.5	67.1	70.1	71.8	73.4	73.9	70.1	71.9	-	70.9	2.1
PNLT	71.7	71.7	68.1	71.8	73.6	74.5	75.3	71.4	73.3	-	72.3	2.2

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* -- UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** -- A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** -- UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-4H.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/24/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 4H (SOFT) - 300 M. WEST JUNE 7,1983

FLIGHT IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	42.0	42.0	42.8	44.1	42.3	42.3	42.1	42.2	42.5	-2.2	42.5	0.7
15	50.7	52.3	51.3	51.2	51.7	50.4	50.3	51.3	51.2	11.8	51.1	0.7
16	62.4	63.4	62.3	61.7	62.6	61.4	61.7	62.5	62.3	27.7	62.2	0.6
17	53.4	53.7	56.1	51.3	53.4	53.5	52.9	54.2	53.7	23.5	53.6	1.3
18	64.7	65.5	61.3	68.0	67.9	59.5	62.6	61.2	64.8	38.6	63.8	3.2
19	55.4	56.2	54.8	57.6	57.4	54.9	55.8	56.5	56.2	33.7	56.1	1.1
20	50.8	52.5	54.3	55.3	54.6	55.7	55.3	54.3	54.3	35.2	54.1	1.7
21	58.6	58.2	63.9	66.2	65.0	57.9	61.7	63.5	62.9	46.8	61.9	3.3
22	52.0	55.0	57.2	57.7	56.8	56.9	57.0	56.1	56.4	43.0	56.1	1.8
23	55.9	57.1	59.8	62.8	60.3	60.0	61.2	56.4	59.8	48.9	59.2	2.5
24	53.8	58.3	58.8	61.9	59.0	60.1	60.7	55.1	59.1	50.5	58.5	2.8
25	50.4	57.0	57.0	60.9	55.8	58.9	59.2	53.6	57.6	51.0	56.6	3.4
26	46.8	53.6	53.0	56.9	50.2	55.6	56.6	50.4	54.0	49.2	52.9	3.6
27	42.1	47.6	47.3	51.4	45.5	50.8	51.2	45.0	48.6	45.4	47.6	3.4
28	30.9	36.9	36.4	41.5	36.0	40.1	38.8	33.9	37.9	36.0	36.8	3.4
29	30.2	38.3	35.6	39.9	36.3	38.8	39.4	32.8	37.4	36.6	36.4	3.4
30	30.2	38.3	36.9	40.2	37.7	40.0	40.7	34.4	38.3	38.3	37.3	3.5
31	29.6	38.6	37.0	39.6	36.6	39.3	40.0	33.7	37.8	38.4	36.8	3.6
32	29.8	36.7	36.5	38.4	36.2	38.8	40.5	33.3	37.2	38.2	36.3	3.4
33	28.7	35.4	35.1	36.8	33.7	36.8	37.9	31.7	35.3	36.5	34.5	3.1
34	27.5	34.6	33.9	35.7	32.3	35.7	37.2	31.3	34.3	35.6	33.5	3.1
35	-	32.8	31.3	32.8	29.2	33.0	35.1	29.1	32.4	33.6	31.9	2.2
36	-	30.6	29.1	29.9	-	30.0	32.4	-	30.6	31.6	30.4	1.2
37	-	29.1	27.9	27.1	-	28.8	29.8	-	28.6	29.1	28.5	1.1
38	-	22.6	22.8	21.4	-	23.0	24.2	-	22.9	22.8	22.8	1.0
39	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-
AL	51.9	56.4	57.1	60.3	56.8	58.3	59.1	54.5	57.4	57.4	56.8	2.7
OASPL	68.6	69.9	69.8	72.8	71.8	68.9	70.1	69.0	70.4	-	70.1	1.5
PNL	63.7	68.4	68.7	71.9	68.9	69.8	70.7	66.8	69.2	-	68.6	2.5
PNLT	65.4	70.1	70.0	74.1	71.0	70.7	72.1	68.2	70.9	-	70.2	2.6

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-4H.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/24/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 4H (SOFT) - 300 M. WEST JUNE 7,1983

GROUND IDLE*****

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	43.5	-	42.7	-	42.2	-	41.5	-	42.5	-2.2	42.5	0.8
15	43.2	-	45.2	-	42.7	-	41.9	-	43.4	4.0	43.2	1.4
16	50.3	-	48.4	-	50.5	-	46.2	-	49.2	14.6	48.8	2.0
17	43.1	-	44.2	-	42.7	-	43.1	-	43.3	13.1	43.3	0.6
18	43.8	-	44.8	-	43.5	-	45.0	-	44.3	18.1	44.3	0.7
19	45.8	-	50.4	-	44.7	-	48.8	-	48.0	25.5	47.4	2.6
20	47.1	-	48.1	-	45.3	-	48.0	-	47.3	28.2	47.1	1.3
21	44.2	-	50.0	-	45.1	-	49.9	-	48.1	32.0	47.3	3.1
22	44.3	-	50.3	-	44.9	-	50.3	-	48.3	34.9	47.4	3.3
23	44.3	-	49.3	-	48.1	-	48.8	-	48.0	37.1	47.6	2.3
24	44.4	-	49.9	-	51.6	-	48.5	-	49.3	40.7	48.6	3.1
25	40.3	-	46.3	-	47.9	-	45.4	-	45.7	39.1	45.0	3.3
26	33.6	-	40.4	-	38.5	-	40.6	-	39.0	34.2	38.3	3.3
27	31.4	-	36.3	-	35.2	-	36.7	-	35.3	32.1	34.9	2.4
28	25.9	-	31.0	-	28.0	-	27.2	-	28.5	26.6	28.0	2.2
29	24.7	-	31.5	-	28.5	-	26.8	-	28.6	27.8	27.9	2.9
30	23.7	-	28.7	-	26.6	-	25.8	-	26.6	26.6	26.2	2.1
31	23.4	-	26.2	-	25.1	-	26.0	-	25.3	25.9	25.2	1.3
32	23.7	-	25.5	-	23.9	-	26.1	-	24.9	25.9	24.8	1.2
33	23.4	-	25.1	-	23.4	-	26.2	-	24.7	25.9	24.5	1.4
34	26.2	-	26.2	-	24.1	-	27.1	-	26.0	27.3	25.9	1.3
35	28.3	-	27.4	-	25.1	-	28.0	-	27.4	28.6	27.2	1.4
36	26.8	-	27.8	-	25.5	-	25.8	-	26.6	27.6	26.5	1.0
37	24.0	-	24.0	-	22.2	-	23.7	-	23.5	24.0	23.5	0.9
38	22.3	-	20.7	-	19.2	-	20.5	-	20.8	20.7	20.7	1.3
39	25.1	-	22.5	-	17.8	-	21.3	-	22.4	21.3	21.7	3.0
40	17.3	-	-	-	-	-	-	-	17.3	14.8	17.3	-
AL	42.3	-	47.1	-	46.9	-	46.4	-	46.0	46.0	45.7	2.3
OASPL	56.1	-	59.1	-	57.8	-	58.3	-	57.9	-	57.8	1.3
PNL	54.3	-	59.0	-	58.3	-	58.0	-	57.9	-	57.4	2.1
PNLT	55.2	-	59.6	-	58.9	-	58.6	-	58.5	-	58.1	2.0

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

***** - TABULATED LEVELS ARE CONTAMINATED BY LOCAL AMBIENT

TABLE NO. C.2-4H.4

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 4H (SOFT) - 300 M. WEST JUNE 7,1983

HOVER-OUT-OF-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	47.3	46.6	47.1	48.8	50.1	48.2	47.3	49.5	48.3	3.6	48.1	1.3
15	53.4	54.8	54.7	55.3	57.6	54.8	54.4	53.8	55.0	15.6	54.8	1.3
16	65.9	67.0	66.8	67.2	69.7	67.1	66.7	66.1	67.2	32.6	67.1	1.2
17	55.6	56.8	55.3	56.5	59.6	57.1	56.2	55.5	56.8	26.6	56.6	1.4
18	67.7	68.4	65.6	69.4	71.5	66.3	62.9	63.9	67.8	41.6	67.0	2.9
19	59.4	60.8	59.9	61.7	65.0	61.4	58.5	57.3	61.1	38.6	60.5	2.3
20	54.0	56.8	58.4	60.7	64.4	59.7	55.7	54.9	59.4	40.3	58.1	3.5
21	65.2	62.1	66.2	66.5	70.6	63.8	67.3	65.2	66.5	50.4	65.9	2.5
22	59.3	60.9	61.3	64.1	68.2	64.0	60.5	59.8	63.3	49.9	62.3	3.0
23	61.4	62.7	62.2	64.2	70.4	66.0	65.3	60.2	65.3	54.4	64.0	3.2
24	58.6	63.3	63.0	65.9	71.0	67.1	61.8	63.2	65.8	57.2	64.2	3.7
25	58.1	62.1	61.3	65.8	70.7	67.5	59.6	60.3	65.2	58.6	63.2	4.4
26	54.6	57.8	57.1	60.9	65.3	63.0	55.9	55.3	60.4	55.6	58.7	3.9
27	47.3	53.0	50.3	52.8	60.1	55.4	49.3	49.7	54.2	51.0	52.2	4.1
28	46.9	45.4	51.4	52.8	59.9	53.9	46.7	47.4	53.4	51.5	50.5	4.9
29	50.5	47.5	53.7	57.3	62.1	55.5	49.9	51.0	55.9	55.1	53.4	4.7
30	52.5	49.9	55.2	60.1	63.6	57.6	51.3	52.7	57.8	57.8	55.4	4.7
31	53.2	50.4	56.0	61.6	63.7	57.3	51.9	52.8	58.3	58.9	55.9	4.8
32	51.7	49.3	54.7	60.0	61.1	54.7	53.4	51.5	56.4	57.4	54.5	4.1
33	51.1	47.6	53.7	58.9	59.3	53.5	50.7	50.3	54.9	56.1	53.1	4.1
34	50.4	45.8	53.2	57.9	57.4	52.2	50.5	49.1	53.7	55.0	52.1	4.1
35	49.5	43.3	51.2	55.1	54.6	49.6	49.0	47.1	51.3	52.5	49.9	3.8
36	47.2	40.5	48.4	51.3	51.3	46.4	45.8	44.3	48.1	49.1	46.9	3.6
37	47.4	38.8	47.1	48.1	48.2	46.9	46.0	45.3	46.6	47.1	46.0	3.1
38	41.4	35.1	42.0	41.9	42.5	39.7	39.9	39.3	40.7	40.6	40.2	2.4
39	35.9	29.5	35.3	34.4	35.1	33.2	33.0	32.2	34.0	32.9	33.6	2.1
40	26.6	21.4	25.6	24.7	25.4	-	-	-	25.1	22.6	24.7	2.0
AL	62.9	62.6	65.4	69.7	72.7	67.8	63.5	63.1	67.6	67.6	66.0	3.7
OASPL	73.0	73.8	73.8	76.3	80.0	75.7	73.5	72.5	75.6	-	74.8	2.5
PNL	76.2	75.3	78.4	82.3	84.8	80.4	76.7	75.9	79.8	-	78.7	3.4
PNLT	77.9	76.9	79.8	84.0	86.3	81.7	78.2	77.2	81.3	-	80.2	3.4

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-5H.1

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

DOT/TSC
4/25/84

SITE: 5H (HARD) - 150 M. NORTH JUNE 7,1983

HOVER-IN-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	54.0	52.1	51.6	55.6	56.3	55.1	55.4	55.7	54.8	10.1	54.5	1.8
15	61.0	61.7	60.3	61.0	62.6	60.0	62.8	60.0	61.3	21.9	61.2	1.1
16	74.4	74.8	73.5	73.8	75.7	72.8	75.7	72.9	74.3	39.7	74.2	1.1
17	62.7	63.5	61.3	62.7	63.5	64.8	64.2	61.9	63.2	33.0	63.1	1.2
18	71.4	72.2	68.8	77.7	80.1	74.8	73.4	71.2	75.2	49.0	73.7	3.7
19	66.0	67.4	65.2	70.6	72.2	71.8	70.4	66.4	69.5	47.0	68.7	2.8
20	61.6	63.3	63.2	67.6	71.1	69.3	68.8	62.2	67.2	48.1	65.9	3.7
21	69.4	67.5	68.0	73.8	77.9	73.6	76.2	70.3	73.6	57.5	72.1	3.9
22	67.4	68.1	66.5	73.7	76.5	74.6	72.7	69.0	72.4	59.0	71.1	3.8
23	68.8	69.1	67.2	74.7	79.2	77.2	77.1	69.7	74.9	64.0	72.9	4.7
24	67.1	70.0	66.5	75.3	79.8	78.9	75.1	69.8	75.3	66.7	72.8	5.2
25	67.8	69.9	65.5	76.0	80.6	80.5	75.7	70.1	76.2	69.6	73.3	5.7
26	67.1	68.4	64.8	74.6	79.9	80.3	76.2	69.8	75.7	70.9	72.6	5.9
27	67.6	68.6	68.2	74.4	79.6	79.7	76.9	70.8	75.6	72.4	73.2	5.1
28	66.7	69.5	68.6	74.0	77.9	77.8	76.2	70.3	74.4	72.5	72.6	4.4
29	65.1	68.4	65.9	70.7	74.4	73.1	73.2	67.0	71.0	70.2	69.7	3.6
30	62.3	66.0	61.5	68.2	72.9	70.9	70.6	64.2	68.7	68.7	67.1	4.2
31	60.0	64.3	60.5	66.5	71.2	69.0	68.4	62.3	66.9	67.5	65.3	4.2
32	57.0	62.0	57.6	64.1	68.1	65.5	66.3	59.6	64.1	65.1	62.5	4.1
33	55.3	59.0	54.6	61.5	66.1	62.4	61.9	56.2	61.2	62.4	59.6	4.0
34	55.4	56.2	52.4	60.1	63.6	60.0	60.3	54.1	59.2	60.5	57.8	3.8
35	55.9	53.5	50.2	58.0	61.1	57.5	58.6	53.5	57.1	58.3	56.0	3.5
36	54.5	51.1	48.4	55.4	58.2	55.1	56.1	52.0	54.7	55.7	53.8	3.1
37	56.3	50.7	48.9	54.0	55.5	55.0	56.7	52.6	54.4	54.9	53.7	2.8
38	51.8	48.3	45.7	50.9	52.6	50.8	52.3	49.6	50.7	50.6	50.2	2.3
39	50.3	46.0	43.4	48.5	49.6	48.5	49.2	47.4	48.3	47.2	47.9	2.2
40	45.6	41.6	38.4	43.6	44.4	43.6	44.3	43.2	43.5	41.0	43.1	2.2
AL	72.9	75.2	72.7	79.4	83.8	83.2	81.2	75.1	79.8	79.8	77.9	4.5
OASPL	80.3	81.4	79.4	85.6	89.5	88.3	86.5	81.2	85.5	-	84.0	3.9
PNL	85.0	86.1	83.8	90.7	95.1	94.0	92.2	86.4	91.0	-	89.2	4.4
PNLT	86.1	87.2	84.7	92.6	97.1	95.1	93.2	87.6	92.5	-	90.4	4.6

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* -- UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** -- UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-5H.2

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR)

DOT/TSC
4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 5H (HARD) - 150 M. NORTH JUNE 7,1983

FLIGHT IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	51.7	50.0	50.1	50.3	53.5	49.5	54.8	50.8	51.7	7.0	51.3	1.9
15	60.4	59.3	59.8	59.3	59.8	59.5	61.5	59.5	59.9	20.5	59.9	0.7
16	72.4	71.1	72.0	71.0	71.5	71.2	73.3	71.3	71.8	37.2	71.7	0.8
17	62.5	61.3	63.9	61.3	61.5	61.7	63.3	64.5	62.7	32.5	62.5	1.3
18	73.7	71.0	73.0	75.1	75.2	72.0	71.5	71.2	73.1	46.9	72.8	1.7
19	64.8	64.3	64.1	67.0	65.8	64.5	67.6	68.1	66.0	43.5	65.8	1.6
20	61.1	60.5	62.7	62.5	62.8	63.2	66.8	63.1	63.2	44.1	62.8	1.9
21	67.0	67.2	70.6	65.6	73.4	71.7	76.1	70.0	71.5	55.4	70.2	3.5
22	63.3	65.4	65.5	63.9	66.6	68.1	75.7	70.0	69.4	56.0	67.3	4.0
23	67.5	67.8	69.0	70.3	70.6	72.2	77.3	72.8	72.1	61.2	70.9	3.2
24	66.2	69.3	69.4	70.0	70.7	72.3	78.2	71.5	72.4	63.8	70.9	3.5
25	64.0	68.8	68.9	70.3	69.6	73.5	78.3	70.8	72.4	65.8	70.5	4.1
26	62.7	68.2	67.7	68.4	67.3	73.0	78.2	70.5	71.9	67.1	69.5	4.6
27	63.4	67.4	70.3	70.1	67.3	73.5	77.1	69.6	71.6	68.4	69.8	4.1
28	61.2	67.1	69.6	72.5	65.2	71.8	74.4	68.0	70.3	68.4	68.7	4.3
29	60.5	68.1	67.4	68.7	64.1	69.6	72.7	67.7	68.5	67.7	67.3	3.7
30	58.6	65.3	65.4	67.8	63.5	68.0	72.5	66.1	67.4	67.4	65.9	4.0
31	56.9	64.3	64.1	65.5	61.7	65.5	69.6	63.7	65.1	65.7	63.9	3.6
32	55.9	61.6	61.6	63.8	60.9	64.8	68.8	64.2	64.0	65.0	62.7	3.7
33	54.3	59.4	58.4	60.7	59.8	63.2	66.4	60.7	61.6	62.8	60.4	3.5
34	53.8	57.6	56.4	58.3	58.8	61.8	65.6	59.1	60.3	61.6	58.9	3.5
35	54.5	56.5	55.0	56.1	56.9	59.9	63.6	57.8	58.6	59.8	57.5	3.0
36	54.0	55.8	54.4	53.5	55.4	58.0	61.6	57.2	57.1	58.1	56.2	2.7
37	52.7	54.4	53.6	51.9	53.2	56.5	59.1	56.2	55.3	55.8	54.7	2.4
38	50.4	51.7	51.4	49.0	50.7	53.3	55.7	53.1	52.4	52.3	51.9	2.1
39	48.6	49.4	49.0	46.3	47.7	50.0	51.3	50.5	49.3	48.2	49.1	1.6
40	53.8	53.7	49.2	42.1	42.6	45.0	46.2	54.4	50.7	48.2	48.4	5.1
AL	69.5	74.6	75.1	76.7	73.7	78.2	82.2	75.9	77.1	77.1	75.7	3.7
OASPL	78.9	79.8	80.9	81.7	81.4	83.0	87.2	81.8	82.6	-	81.8	2.5
PNL	82.8	86.0	86.6	87.7	86.1	89.7	93.9	88.0	88.8	-	87.6	3.2
PNLT	84.5	87.3	88.1	89.6	88.0	91.2	94.9	89.0	90.2	-	89.1	3.0

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-5H.3

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) DOT/TSC 4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 5H (HARD) - 150 M. NORTH JUNE 7,1983

GROUND IDLE

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES)								AVERAGE LEVEL OVER 360 DEGREES			
	0	45	90	135	180	225	270	315	ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	43.8	-	44.7	-	44.5	-	51.9	-	47.7	3.0	46.2	3.8
15	44.6	-	46.0	-	48.6	-	51.4	-	48.4	9.0	47.6	3.0
16	57.1	-	54.3	-	60.2	-	54.5	-	57.2	22.6	56.5	2.8
17	45.1	-	47.3	-	46.4	-	49.4	-	47.3	17.1	47.0	1.8
18	49.0	-	49.9	-	47.3	-	54.0	-	50.8	24.6	50.0	2.8
19	53.5	-	60.3	-	51.9	-	58.0	-	57.2	34.7	55.9	3.9
20	51.5	-	55.3	-	51.8	-	57.4	-	54.7	35.6	54.0	2.8
21	51.7	-	57.8	-	50.8	-	59.4	-	56.4	40.3	54.9	4.3
22	54.8	-	59.2	-	54.4	-	59.6	-	57.6	44.2	57.0	2.8
23	56.2	-	59.4	-	59.2	-	59.0	-	58.6	47.7	58.4	1.5
24	58.3	-	60.4	-	62.5	-	59.0	-	60.4	51.8	60.0	1.9
25	55.1	-	58.1	-	59.7	-	56.5	-	57.7	51.1	57.3	2.0
26	51.7	-	56.8	-	52.9	-	55.7	-	54.7	49.9	54.3	2.4
27	53.0	-	60.8	-	53.5	-	57.0	-	57.3	54.1	56.1	3.6
28	50.9	-	58.8	-	51.4	-	55.7	-	55.4	53.5	54.2	3.7
29	49.4	-	56.1	-	49.8	-	53.3	-	53.0	52.2	52.1	3.2
30	49.9	-	53.5	-	47.0	-	50.7	-	50.9	50.9	50.3	2.7
31	49.4	-	52.5	-	45.9	-	49.5	-	49.9	50.5	49.3	2.7
32	51.0	-	50.8	-	45.1	-	49.0	-	49.5	50.5	49.0	2.7
33	50.8	-	49.6	-	43.1	-	48.5	-	48.8	50.0	48.0	3.4
34	53.1	-	49.8	-	41.6	-	50.0	-	50.2	51.5	48.6	4.9
35	55.5	-	51.6	-	42.1	-	50.1	-	51.9	53.1	49.8	5.6
36	54.7	-	51.2	-	40.9	-	47.3	-	50.9	51.9	48.5	5.9
37	53.9	-	47.1	-	37.2	-	45.0	-	49.2	49.7	45.8	6.9
38	54.1	-	46.2	-	36.3	-	44.5	-	49.2	49.1	45.3	7.3
39	61.9	-	53.3	-	37.0	-	51.1	-	56.8	55.7	50.8	10.3
40	48.5	-	43.2	-	34.6	-	39.0	-	44.1	41.6	41.3	5.9
AL	65.9	-	65.4	-	60.5	-	63.1	-	64.2	64.2	63.7	2.5
OASPL	68.4	-	70.0	-	68.0	-	69.1	-	69.0	-	68.9	0.9
PNL	80.0	-	78.1	-	72.9	-	76.5	-	77.8	-	76.9	3.0
PNLT	81.8	-	79.6	-	73.4	-	78.0	-	79.5	-	78.2	3.6

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* -- UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** -- UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

TABLE NO. C.2-5H.4

AEROSPATIALE SA-355F HELICOPTER (TWINSTAR) — DOT/TSC 4/25/84

1/3 OCTAVE NOISE DATA -- STATIC TESTS

AS MEASURED****

SITE: 5H (HARD) - 150 M. NORTH JUNE 7,1983

HOVER-OUT-OF-GROUND-EFFECT

BAND NO.	LEVELS @ ACOUSTIC EMMISION ANGLES OF (DEGREES) 0	45	90	135	180	225	270	315	AVERAGE LEVEL OVER 360 DEGREES ENERGY *	AVE **	ARITH ***	Std Dv
	SOUND PRESSURE LEVEL dB re 20 microPascal											
14	55.3	54.9	53.7	56.1	59.4	58.5	59.4	58.4	57.4	12.7	57.0	2.2
15	60.9	63.1	62.0	61.1	64.6	65.7	64.5	64.1	63.6	24.2	63.2	1.8
16	74.0	76.2	75.4	73.9	77.9	78.8	77.5	77.3	76.7	42.1	76.4	1.8
17	63.2	64.6	61.6	63.1	65.6	70.2	64.9	64.1	65.5	35.3	64.7	2.6
18	74.2	76.5	71.9	78.0	79.7	78.5	72.5	74.9	76.6	50.4	75.8	2.9
19	67.0	70.0	67.7	70.6	74.6	75.9	69.7	69.1	71.7	49.2	70.6	3.1
20	62.5	64.6	66.0	66.4	72.7	74.9	71.1	65.2	69.9	50.8	67.9	4.4
21	72.6	70.7	73.2	73.5	78.8	78.7	76.9	75.4	75.8	59.7	75.0	3.0
22	68.3	70.5	70.4	72.5	77.7	80.9	73.9	71.4	75.2	61.8	73.2	4.2
23	72.0	71.9	72.9	73.6	79.2	82.1	77.7	73.8	77.0	66.1	75.4	3.8
24	67.2	75.8	73.7	73.3	79.0	82.9	74.4	71.5	77.0	68.4	74.7	4.7
25	68.2	75.6	73.4	74.6	78.7	83.0	73.6	70.4	77.0	70.4	74.7	4.6
26	66.8	73.5	72.3	73.2	75.7	82.3	71.3	69.7	75.7	70.9	73.1	4.6
27	63.7	73.0	72.0	72.5	72.8	80.2	69.7	69.1	73.9	70.7	71.6	4.6
28	60.6	72.4	70.6	72.1	67.3	75.2	65.8	66.5	70.7	68.8	68.8	4.7
29	53.6	70.3	63.5	67.7	67.4	67.7	65.4	60.8	66.4	65.6	64.5	5.3
30	55.4	67.4	61.0	63.2	72.0	73.8	69.4	61.2	68.7	68.7	65.4	6.3
31	58.5	65.6	65.7	62.1	72.8	75.6	69.9	63.9	69.8	70.4	66.8	5.7
32	59.5	66.2	67.2	64.0	69.5	73.1	68.1	65.2	68.1	69.1	66.6	4.0
33	57.1	65.2	65.0	64.0	62.6	68.9	61.5	62.1	64.4	65.6	63.3	3.4
34	53.9	63.1	59.5	62.6	65.0	66.0	62.1	59.0	62.6	63.9	61.4	3.9
35	55.7	60.4	57.3	59.0	61.4	64.6	59.6	57.9	60.3	61.5	59.5	2.7
36	54.1	57.6	55.0	56.3	59.4	61.5	56.7	55.7	57.7	58.7	57.0	2.4
37	56.8	56.4	54.1	55.1	56.3	58.8	56.5	56.5	56.5	57.0	56.3	1.4
38	52.0	53.4	50.9	51.6	53.4	54.6	52.4	52.8	52.8	52.7	52.6	1.2
39	49.2	50.6	47.6	48.7	49.8	51.0	49.4	50.3	49.7	48.6	49.6	1.1
40	44.9	46.2	42.6	43.7	44.4	45.3	44.3	45.8	44.8	42.3	44.6	1.2
AL	71.1	78.9	77.2	77.7	81.1	85.3	78.1	75.1	79.8	79.8	78.1	4.1
OASPL	81.0	84.9	83.5	84.7	88.4	91.4	85.4	83.7	86.6	-	85.4	3.2
PNL	84.9	90.7	89.0	89.8	93.4	97.2	90.6	88.0	91.9	-	90.4	3.7
PNLT	86.4	92.2	90.2	91.6	95.0	98.1	91.5	89.4	93.3	-	91.8	3.5

BANDS 14 TO 40 - STANDARD 1/3 OCTAVE BANDS 25 TO 10KHz

* - UNWEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
** - A-WEIGHTED ENERGY AVERAGE OF MEASURED LEVELS OVER 360 DEGREES
*** - UNWEIGHTED ARITHMETIC AVERAGE OF MEASURED LEVELS OVER 360 DEGREES

**** - 32 SECOND AVERGING TIME

APPENDIX D

Direct Read Acoustical Data for Static Operations

This appendix contains time averaged, A-weighted sound level data (Leq values) obtained using direct read Precision Integrating Sound Level meters. Data are presented for microphone locations 5H, 2, and 4 (see Figure 3.3).

A description of the measurement systems is provided in Section 5.6.2, and a figure of the typical PISLM system is shown in Figure 5.4. Data are shown in Table D-1, depicting the equivalent sound levels for eight different source emission angles. In each case the angle is indexed to the specific measurement site. A figure showing the emission angle convention is included in the text (Figure 6.1). In each case, the Leq (or time averaged AL) represents an average over a sample period of approximately 60 seconds.

Quantities appearing in this appendix include:

HIGE	Hover-in-ground-effect, skid height 5 feet above ground level
HOGE	Hover-out-of-ground-effect, skid height 30 feet above ground level
Flight Idle	Skids on ground
Ground Idle	Skids on ground

TABLE D.1.1

STATIC OPERATIONS
DIRECT READ DATA
(ALL VALUES A-WEIGHTED LEQ, EXPRESSED IN DECIBLES)

TWINSTAR

6-7-83

SITE 4H (SOFT SITE)

HIGE		FLT.IDLE		GRN.IDLE		HOGE	
I-0	58.40	J-0A	55.30	J-0B	44.40	K-0	64.70
I-315	60.40	J-315A	57.80	J-315B	NA	K-315	65.50
I-270	63.60	J-270A	61.50	J-270B	48.70	K-270	65.60
I-225	64.10	J-225A	60.80	J-225B	NA	K-225	69.60
I-180	63.60	J-180A	59.20	J-180B	49.40	K-180	74.60
I-135	60.80	J-135A	62.70	J-135B	NA	K-135	75.40
I-90	58.80	J-90A	59.10	J-90B	49.40	K-90	67.30
I-45	61.60	J-45A	59.20	J-45B	NA	K-45	64.70

SITE 2 (SOFT SITE)

HIGE		FLT.IDLE		GND.IDLE		HOGE	
I-0	67.90	J-0A	65.40	J-0B	54.50	K-0	72.80
I-315	70.70	J-315A	67.80	J-315B	NA	K-315	75.30
I-270	73.80	J-270A	72.10	J-270B	58.50	K-270	75.50
I-225	75.20	J-225A	72.40	J-225A	NA	K-225	79.70
I-180	76.20	J-180A	69.00	J-180B	NA	K-180	83.50
I-135	73.00	J-135A	73.60	J-135B	NA	K-135	80.20
I-90	70.90	J-90A	69.70	J-90B	58.90	K-90	75.90
I-45	72.60	J-45A	NA	J-45B	NA	K-45	77.10

TABLE D.1.2

STATIC OPERATIONS
DIRECT READ DATA
(ALL VALUES A-WEIGHTED LEQ, EXPRESSED IN DECIBLES)

TWINSTAR

6-7-83

SITE 5H (HARD SITE)

HIGE		FLT.IDLE		GRN.IDLE		HOGE	
I-90	72.60	J-90A	75.60	J-90B	65.40	K-90	78.30
I-45	76.40	J-45A	75.00	J-45B	NA	K-45	79.40
I-0	74.00	J-0A	70.30	J-0B	65.90	K-0	72.20
I-315	77.30	J-315A	76.50	J-315B	NA	K-315	76.00
I-270	81.50	J-270A	83.00	J-270B	64.60	K-270	77.70
I-225	84.90	J-225A	78.80	J-225B	NA	K-225	86.10
I-180	85.30	J-180A	74.90	J-180B	62.00	K-180	81.90
I-135	79.90	J-135A	77.40	J-135B	NA	K-135	NA

SITE 7H (HARD SITE)

HIGE		FLT.IDLE		GND.IDLE		HOGE	
I-90	67.23	J-90A	69.85	J-90B	58.66	K-90	75.05
I-45	71.23	J-45A	68.02	J-45B	NA	K-45	77.06
I-0	69.89	J-0A	63.58	J-0B	55.49	K-0	68.67
I-315	73.11	J-315A	71.68	J-315B	NA	K-315	72.65
I-270	78.68	J-270A	77.38	J-270B	57.64	K-270	75.33
I-225	80.62	J-225A	73.59	J-225B	NA	K-225	83.14
I-180	79.87	J-180A	67.73	J-180B	55.85	K-180	78.64
I-135	73.98	J-135A	71.15	J-135B	NA	K-135	76.34

APPENDIX E

Cockpit Instrument Photo Data

During each event of the June 1983 Helicopter Noise Measurement program cockpit photos were taken. The slides were projected onto a screen (considerably enlarged) making it possible to read the instruments with reasonable accuracy. The photos were supposed to be taken when the aircraft was directly over the centerline-center microphone site. Although this was not achieved in each case the cockpit photos reflect the helicopter "stabilized" configuration during the test event. One important caution is necessary in interpreting the photographic information; the snapshot freezes instrument readings at one moment of time whereas most readings are constantly changing by a small amount as the pilot "hunts" for the reference condition. Thus fluctuations above or below reference conditions are to be anticipated. The instrument readings are most useful in terms of verifying the region of operation for different parameters. The data acquisition is discussed in Section 5.3

Each table within this appendix provides the following information:

Event No.	This event number along with the test date provides a cross reference to other data.
Event Type	This specifies the event.
Time of Photo	The time of the range control synchronized clock consistent with acoustical and tracking time bases.
Heading	The compass magnetic heading which fluctuates around the target heading.
Altimeter	Specifies the barometric altimeter reading, one of the more stable indicators.
IAS	Indicated airspeed, a fairly stable indicator.
Rotor Speed	Main Rotor speed in RPM or percent, a very stable indicator.
Torque	The torque on the main rotor shaft, a fairly stable value.

TABLE E.1

COCKPIT PHOTO DATA

HELICOPTER TwinStar **TEST DATE** 6/7/83

EVENT NO.	EVENT TYPE	TIME OF PHOTO	HEADING (DEGREES)	ALTIMETER (AGL) FT. (METERS)	IAS (KTS)	ROTOR SPEED (RPM OR %)	TORQUE (%)
		6:07	350		71	385	65
I030	HIGE	6:09	30		59	385	65
I075	HIGE	6:11	75		52	385	65
I120	HIGE	6:12	120		53	385	64
I165	HIGE	6:14	165		52	385	64
I210	HIGE	6:16	210		56	385	64
I255	HIGE	6:17	255		53	385	64
J300b	GROUND IDLE	6:22	305		51	380	20
	GROUND IDLE	6:22	300		51	265	10
J345a	FLIGHT IDLE	6:25	350		50	385	20
J030a	FLIGHT IDLE	6:27	030		47	385	22
J075a	FLIGHT IDLE	6:32	075		48	380	22
J120a	FLIGHT IDLE	6:34	120		48	385	22
J165a	FLIGHT IDLE	6:39	165		51	385	24
J210a	FLIGHT IDLE	6:39	210		52	385	22
J210b	GROUND IDLE	6:41	210		54	225	10
J255a	FLIGHT IDLE	6:43	260		52	385	22
K300	HOGE	6:46	305		60	385	66
K345	HOGE	6:47	350		62	385	65
K345	HOGE	6:48	350		63	385	65
K030	HOGE	6:49	030		64	385	65
K075	HOGE	6:50	075		62	385	65
K120	HOGE	6:52	120		60	385	66
K165	HOGE	6:54	165		60	385	68
K210	HOGE	6:55	210		60	385	66
K255	HOGE	6:57	260		60	385	62
		6:59			132	390	66
A1	LFO 500 0.9VH	7:55	300		132	390	68
A2	LFO 500'0.9VH	7:57	120		132	390	62
A3	LFO 500'0.9VH	8:00	300		132	390	70
A4	LFO 500'0.9VH	8:02	120		134	390	70
A5	LFO 500'0.9VH	8:04	300		134	390	66
		8:05	120		130	390	66
A6	LFO 500'0.9VH	8:09	300		133	390	66

TABLE E.2

COCKPIT PHOTO DATA

HELICOPTER TwinStar (CONT) TEST DATE 6/7/83

EVENT NO.	EVENT TYPE	TIME OF PHOTO	HEADING (DEGREES)	ALTIMETER (AGL) FT. (METERS)	IAS (KTS)	ROTOR SPEED (RPM OR %)	TORQUE (%)
B7	LFO 500'0.8VH	8:12	120		115	390	56
B8	LFO 500'0.8VH	8:15	315		118	390	55
B9	LFO 500'0.8VH	8:17	125		115	390	54
B10	LFO 500'0.8VH	8:20	310		114	390	54
B11	LFO 500'0.8VH	8:22	125		112	390	53
B12	LFO 500'0.8VH	8:24	310		117	390	54
B13	LFO 500'0.8VH	8:27	125		112	390	52
C14	LFO 500'0.7VH	8:35	125		101	390	44
C15	LFO 500'0.7VH	8:39	310		100	390	44
C16	LFO 500'0.7VH	8:42	125		102	390	40
C17	LFO 500'0.7VH	8:44	310		102	390	43
C18	LFO 500'0.7VH	8:46	125		102	390	42
D19	LFO 1000'0.9VH	8:49	310		134	390	70
D20	LFO 1000'0.9VH	8:51	125		133	390	65
D21	LFO 1000'0.9VH	8:54	310		135	390	70
D22	LFO 1000'0.9VH	8:56	125		125	390	64
D23	LFO 1000'0.9VH	8:59	310		134	390	68
D24	LFO 1000'0.9VH	9:01	120		134	390	68
D25	LFO 1000'0.9VH	9:04	300		130	390	68
		9:07	310		63	390	70
		9:09	310		71	390	72
E26	T/O ICAO	9:14	310		61	390	72
E27	T/O ICAO	9:19	305		69	385	61
E28	T/O ICAO	9:22			59	385	66
E29	T/O ICAO	9:25	305		71	385	68
E30	T/O ICAO	9:32	305		59	385	70
E31	T/O ICAO	9:35	305		63	385	60
E32	T/O ICAO	9:39			64	385	70
E33	T/O ICAO	9:43			64	385	74

TABLE E.3

COCKPIT PHOTO DATA

HELICOPTER TwinStar (CONT)   TEST DATE 6/7/83

EVENT NO.	EVENT TYPE	TIME OF PHOTO	HEADING (DEGREES)	ALTIMETER (AGL) FT. (METERS)	IAS (KTS)	ROTOR SPEED (RPM OR %)	TORQUE (%)
H34	APPROACH	10:33			72	385	
H35	APPROACH	10:37			76	385	14
H36	APPROACH	10:40			72	385	15
H37	APPROACH	10:44			77	385	12
G40	TAKEOFF	10:57	305		71	385	70
G41	TAKEOFF	11:00	310		64	385	68
F42	APPROACH	11:09	140		69	385	30
F43	APPROACH	11:12	130		69	385	20
F44	APPROACH	11:16			72	385	20
F45	APPROACH	11:20			73	385	20
F46	APPROACH	11:23			72	385	22
F47	APPROACH	11:26	120		70	385	26
F48	APPROACH	11:30	120		76	385	24
M49	LFO 500'	11:41			148	385	72
M50	LFO 500'	11:43			142	385	72
M51	LFO 500'	11:45			136	385	72
M52	LFO 500'	11:47			143	385	72
M53	LFO 500'	11:49			140	385	72
N54	LFO 500' 0.9VH	11:34	125		80	385	34
N55	LFO 500' 0.9VH	11:54	305		88	385	34
N56	LFO 500' 0.9VH	11:59	305		90	385	35

APPENDIX F

Photo-Altitude and Flight Path Trajectory Data

This appendix contains the results of the photo-altitude and flight path trajectory analysis.

The helicopter altitude over a given microphone was determined by a photographic technique which involves photographing an aircraft during a flyover event and proportionally scaling the resulting image with the known dimensions of the aircraft. The data acquisition is described in detail in Section 5.2. The detailed data reduction procedures is set out in Section 6.2.1; the analysis of these data is discussed in Section 8.2

Each table within this appendix provides the following information:

Event No.	the test run number
Est. Alt.	estimated altitude above microphone site
P-Alt.	altitude above photo site, determined by photographic technique
Est. CPA	estimated closest point of approach to microphone site
Est. ANG	Helicopter elevation with respect to the ground as viewed from a sideline site as the helicopter passes through a plane perpendicular to the flight track and coincident with the observer location.
ANG 5-1	flight path slope, expressed in degrees, between P-Alt site 5 and P-Alt site 1.
ANG 1-4	flight path slope, expressed in degrees, between P-Alt Site 1 and P-Alt Site 4.
ANG 5-4	flight path slope, expressed in degrees, between P-Alt Site 5 and P-Alt Site 4.
Reg C/D Angle	flight path slope, expressed in degress, of regression line through P-Alt data points.

TABLE F.1

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 500 FT.FLYOVER/TARGET IAS=130.5 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
	EST.		EST.		EST.		EST.	ELEV	EST.	ELEV	ANG	ANG	ANG	C/D
EVENT NO	ALT.	P-ALT.	ALT.	P-ALT.	ALT.	P-ALT.	CPA	ANG	CPA	ANG	5-1	1-4	5-4	ANGLE
A1	532.8	537.2	511.2	515.6	489.6	NA	709.5	46.1	708.1	NA	-2.4	NA	NA	-2.4
A2	472.3	474.9	459.5	462.1	446.7	NA	673.2	43	672.4	NA	-1.4	NA	NA	-1.4
A3	486.1	483.7	467.3	482.7	452.3	448.5	678.6	43.5	680.2	43.4	0	-3.9	-1.9	-1.6
A4	473	472	478.8	NA	482.4	481.4	686.6	44.2	686	NA	NA	NA	.5	.5
A5	516.1	512.4	510.3	521.8	505.6	500.7	708.8	46	709.4	46	1.1	-2.4	-.6	-.4
A6	500	510.2	479	467.1	462.2	474.1	686.6	44.2	688.5	44.1	-4.9	.8	-2	-1.9
AVERAGE	496.7	498.4	484.4	489.9	473.1	476.2	690.6	44.5	690.8	22.3				
STD. DEV	24.3	25.7	21.7	27.5	23.1	246.5	15.3	1.3	15	24.4				

TABLE F.2

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 500 FT.FLYOVER/TARGET IAS=116 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
	EST.		EST.		EST.		EST.	ELEV	EST.	ELEV	ANG	ANG	ANG	C/D
EVENT NO	ALT.	P-ALT.	ALT.	P-ALT.	ALT.	P-ALT.	CPA	ANG	CPA	ANG	5-1	1-4	5-4	ANGLE
B7	522	523.9	504.8	509.6	491.1	492.8	704.9	45.7	706.5	45.7	-1.6	-1.9	-1.7	-1.5
B8	479.7	480.7	479.9	477.4	480.1	481.4	687.3	44.3	687.3	44.3	-.3	.5	0	0
B9	522.3	522.8	519.8	520.3	517.3	NA	715.7	46.6	715.5	NA	-.2	NA	NA	-.2
B10	502.9	504.7	497.8	496.5	493.7	495.7	699.9	45.3	700.4	45.3	-.9	0	-.4	-.4
B11	511.9	515.8	503.7	499.3	497.2	501.7	704.1	45.7	704.9	45.6	-1.8	.3	-.7	-.7
B12	521.2	519.3	530.6	529.8	538.1	536.2	723.6	47.2	722.7	47.2	1.2	.7	1	.9
B13	557	556.5	554.4	556.9	552.4	551.7	741.3	48.4	741.5	48.4	0	-.5	-.2	-.1
AVERAGE	516.7	517.7	513	512.8	510	509.9	711	46.2	711.3	39.5				
STD. DEV	23.4	22.8	24.3	25.8	26.9	194.4	17.6	1.3	17.4	17.5				

TABLE F.3

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 500 FT.FLYOVER/TARGET IAS=110.5 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
C14	524.2	526.3	526.2	520.3	527.7	530.5	720.4	46.9	720.2	46.9	-.6	1.2	.2	.2
C15	456.8	458.1	456.7	453.7	456.7	458.4	671.3	42.9	671.3	42.9	-.4	.5	0	0
C16	477.2	475.8	486.1	NA	491.3	489.9	691.6	44.7	690.8	NA	NA	NA	.8	.8
C17	469.2	472	462.7	459.7	457.6	460.9	675.4	43.2	676	43.2	-1.3	.1	-.5	-.5
C18	484.9	481.7	488.2	493.6	490.8	487	693.1	44.8	692.8	44.8	1.4	-.7	.3	.3
AVERAGE	482.4	482.8	484	481.8	484.8	485.3	690.4	44.5	690.2	35.6				
STD. DEV	25.5	25.8	27.4	31.1	29.4	29.1	19.4	1.6	19.1	19.9				

TABLE F.4

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 1000 FT.FLYOVER/TARGET IAS=130.5 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
D19	912.1	914.3	907.6	905	904.1	906.7	1032.4	61.5	1032.9	61.5	-1	.2	-.3	-.3
D20	963.6	963.4	955.3	960	948.6	948.1	1074.5	62.7	1075.5	62.7	-.3	-1.3	-.8	-.7
D21	971.2	971.5	926.6	949.5	891.1	889.6	1049.1	62	1054.2	61.9	-2.5	-6.8	-4.7	-4
D22	934.1	936.4	919.6	NA	911.1	913.4	1043	61.9	1044.6	NA	NA	NA	-1.2	-1.2
D23	974.2	975.5	973.2	970.7	972.4	974	1090.5	63.2	1090.6	63.2	-.5	.4	0	0
D24	991.7	1009.3	954	934.2	924	944.5	1073.4	62.7	1077.7	62.7	-8.6	1.2	-3.7	-3.4
D25	978	983.8	967.8	960	959.6	966.5	1085.6	63.1	1086.8	63	-2.7	.8	-.9	-.8
AVERAGE	960.7	964.9	943.4	946.6	930.1	934.7	1064.1	62.4	1066	53.6				
STD. DEV	27.8	31.2	25.4	23.8	30.6	31.9	22.5	.6	22.2	23.6				

TABLE F.5

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: ICAO TAKEOFF/TARGET IAS=63 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
E26	402.7	367.6	592.4	571.6	743.7	707.4	770.1	50.3	751.6	51	22.5	15.4	19.1	17.6
E27	427.5	394.5	616.3	591	766.9	733.4	788.6	51.4	769.9	52	21.8	16.1	19	17.5
E28	377.7	336.9	585.4	567.9	751	708.4	764.7	50	744.5	50.7	25.2	15.9	20.7	19.3
E29	402.7	369	615.2	579.2	784.7	751.1	787.8	51.4	766.7	52.1	23.1	19.3	21.2	19.7
E30	398.7	354.2	601.9	595.1	764	716.5	777.4	50.7	757.5	51.4	26.1	13.9	20.2	18.9
E31	407.8	371.8	590.5	575.4	736.2	698.5	768.6	50.2	750.8	50.8	22.5	14	18.4	17
E32	416.1	377.6	619.7	599.2	782	742.1	791.3	51.6	771	52.2	24.2	16.2	20.3	18.9
E33	384.6	338.7	594.2	587	761.3	712.4	771.4	50.4	750.9	51.1	26.8	14.3	20.8	19.5
AVERAGE	402.2	363.8	602	583.3	761.2	721.2	777.5	50.8	757.9	51.4				
STD. DEV	16	19.6	13.4	11.5	17.2	18.7	10.4	.6	10.1	.6				

TABLE F.6

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: ICAO 6 DEGREE APPROACH/TARGET IAS=63 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
F42	302.3	289.8	377.1	365.8	436.7	424.1	619.9	37.5	614.1	37.9	8.8	6.8	7.8	6.9
F43	299.9	287.4	365.1	359	417.1	404.1	612.7	36.6	607.8	36.9	8.3	5.2	6.8	6.1
F44	288.3	276.5	360.1	348.9	417.3	405.4	609.7	36.2	604.3	36.6	8.4	6.6	7.5	6.7
F45	281.4	267	344	343.4	393.9	378.4	600.3	35	595.8	35.3	8.8	4.1	6.5	5.8
F46	300.3	288.6	356.2	353.2	400.8	388.4	607.4	35.9	603.3	36.2	7.5	4.1	5.8	5.2
F47	300.1	285.6	366.9	364.3	420.2	404.8	613.7	36.7	608.7	37.1	9.1	4.7	6.9	6.2
F48	293.3	280.2	356	352.5	406	392.1	607.3	35.9	602.6	36.2	8.4	4.6	6.5	5.8
AVERAGE	295.1	282.2	360.8	355.3	413.1	399.6	610.1	36.3	605.2	36.6				
STD. DEV	7.8	8.2	10.4	8.2	14.2	14.8	6.2	.8	5.7	.8				

TABLE F.7

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: STANDARD TAKEOFF/TARGET IAS=63 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
G38	360.2	364.98	427	381.1	480.2	488.9	651.4	41	645.9	41.3	1.9	12.4	7.2	6.2
G39	383.7	370.72	450.3	444.4	503.4	489.9	667	42.5	661.2	42.8	8.5	5.3	6.9	6.2
G40	331.2	325.6	428.3	389.6	505.7	502.7	652.3	41	644.2	41.5	7.4	12.9	10.2	9
G41	364.1	352.8	477.9	443.3	568.6	559.1	685.9	44.2	675.8	44.7	10.4	13.2	11.8	10.6
AVERAGE	359.8	353.5	445.9	414.6	514.5	510.2	664.2	42.2	656.8	42.6				
STD. DEV	21.7	20.1	23.9	34	37.9	33.2	16.2	1.5	14.8	1.6				

TABLE F.8

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: APPROACH/TARGET IAS=63 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
H34	300.9	286.1	396.6	379.4	473	458.4	632	38.9	624.3	39.4	10.7	9.1	9.9	8.9
H35	303.4	283.1	408.1	398.5	491.6	470.5	639.2	39.7	630.7	40.2	13.2	8.3	10.8	9.7
H36	306.5	289.1	392.1	386.1	460.4	442.1	629.1	38.6	622.4	39	11.2	6.5	8.8	8
H37	301.4	281.6	397.5	391.4	474.2	453.4	632.5	38.9	624.9	39.4	12.6	7.2	9.9	8.9
AVERAGE	303	285	398.6	388.9	474.8	456.1	633.2	39	625.6	39.5				
STD. DEV	2.5	3.3	6.8	8.1	12.8	11.8	4.3	.5	3.6	.5				

TABLE F.9

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 500 FT.FLYOVER/TARGET IAS=145 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
M49	490.8	498.2	483.7	470.9	478.1	487	690	44.5	690.6	44.5	-3.1	1.9	-.6	-.6
M50	513.5	NA	476.7	482.7	447.4	453.4	685.1	44.1	683.2	NA	NA	-3.3	NA	-3.3
M51	478	482.7	474.7	465.9	472	477.7	683.6	44	683.9	44	-1.9	1.4	-.2	-.2
M52	495.9	495	500.2	499.3	504.5	NA	701.6	45.5	701.9	NA	.5	NA	NA	.5
M53	479	479.7	490.3	482.7	499.3	500.7	694.6	44.9	693.6	45	.3	2.1	1.2	1.1
AVERAGE	491.4	488.9	485.1	480.3	480.3	479.7	691	44.6	690.6	26.7				
STD. DEV	14.5	9.1	10.4	12.9	22.9	215.2	7.3	.6	7.7	24.4				

TABLE F.10

HELICOPTER: TWINSTAR

TEST DATE: 6-7-83

OPERATION: 500 FT.FLYOVER/TARGET IAS=130.5 MPH

	CENTERLINE						SIDELINE							
	MIC #5		MIC #1		MIC #4		MIC #2		MIC #3					REG.
EVENT NO	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. ALT.	P-ALT.	EST. CPA	ELEV ANG	EST. CPA	ELEV ANG	ANG 5-1	ANG 1-4	ANG 5-4	C/D ANGLE
N54	477.2	478.3	488.6	480	497.8	499.7	693.4	44.8	692.4	44.9	.2	2.3	1.2	1.1
N55	471.1	470.2	475.7	474.8	480.3	NA	684.4	44	684.7	NA	.5	NA	NA	.5
N56	501.8	510.2	495.5	480	490.5	500.7	698.3	45.2	698.9	45.2	-3.4	2.4	-.5	-.5
AVERAGE	483.4	486.2	486.6	478.3	489.5	500.2	692	44.7	692	30				
STD. DEV	16.3	21.1	10	3	8.8	288.8	7.1	.6	7.1	26				

APPENDIX G

NWS Upper Air Meteorological Data

This appendix presents a summary of meteorological data gleaned from National Weather Service radiosonde (rawinsonde) weather balloon ascensions conducted at Sterling, VA. The data collection is further described in Section 5.4. Tables are identified by launch date and launch time. Within each table the following data are provided:

Time	expressed first in Eastern Standard, then in Eastern Daylight Time
Surface Height	height of launch point with respect to sea level
Height	height above ground level, expressed in feet
Pressure	expressed in millibars
Temperature	expressed in degrees centigrade
Relative Humidity	expressed as a percent
Wind Direction	the direction from which the wind is blowing (in degrees)
Wind Speed	expressed in knots

TABLE G.1

DATE: 6 / 7 / 83

TIME: 600 EST FLIGHT # 1 7:00 EDT

SURFACE HEIGHT= 279 FT MSL -999= MISSING DATA

HEIGHT FEET	PRESSURE MB	TEMPERATURE DEG C	RELATIVE HUMIDITY	WIND DIRECTION	WIND SPEED KTS
0	998.4	17.8	94	340	3
100	994.9	17.9	94	-999	-999
200	991.4	18.1	93	-999	-999
300	987.8	18.2	93	298	26
400	984.3	18.3	89	295	32
500	980.9	18.4	85	303	30
600	977.4	18.5	80	325	17
700	973.9	18.6	77	36	16
800	970.5	18.6	73	20	14
900	967.1	18.7	69	2	15
1000	963.9	18.7	68	340	14
1100	960.7	18.6	68	330	15
1200	957.6	18.5	67	327	16
1300	954.4	18.5	67	323	14
1400	950.8	18.3	68	327	17
1500	947.2	18.1	69	324	16
1600	943.6	17.9	70	312	16
1700	940.0	17.7	71	314	19
1800	936.6	17.4	72	313	21
1900	933.3	17.2	74	311	22
2000	930.0	16.9	75	311	20
2100	926.7	16.7	77	311	19
2200	923.4	16.5	79	310	21
2300	920.0	16.2	80	310	20
2400	916.7	16.0	82	313	17
2500	913.5	15.9	83	313	14
2600	910.2	15.8	84	317	13
2700	907.0	15.7	85	315	14
2800	903.7	15.6	86	300	13
2900	900.5	15.4	87	294	13
3000	897.3	15.3	87	302	15

TABLE G.2

DATE: 6 / 7 / 83

TIME: 655 EST FLIGHT # 2 7:55 EDT

SURFACE HEIGHT= 279 FT MSL -999= MISSING DATA

HEIGHT FEET	PRESSURE MB	TEMPERATURE DEG C	RELATIVE HUMIDITY	WIND DIRECTION	WIND SPEED KTS
0	999.4	18.7	92	330	3
100	995.8	18.5	93	-999	-999
200	992.3	18.4	90	-999	-999
300	988.8	18.3	88	-999	-999
400	985.3	18.1	85	349	11
500	981.8	18.0	82	342	13
600	978.3	17.9	80	349	13
700	974.9	17.8	77	334	17
800	971.6	17.6	77	336	17
900	968.4	17.5	77	334	17
1000	965.2	17.3	76	331	19
1100	961.9	17.1	76	334	18
1200	958.7	17.0	76	333	21
1300	954.9	16.9	75	333	21
1400	951.2	16.9	73	333	22
1500	947.5	16.8	72	328	27
1600	944.1	16.8	69	333	26
1700	940.8	16.6	67	335	21
1800	937.4	16.4	67	330	25
1900	934.0	16.2	66	329	23
2000	930.7	16.0	67	326	20
2100	927.4	15.8	67	326	20
2200	924.1	15.6	70	326	22
2300	920.8	15.3	73	324	21
2400	917.5	15.0	76	321	19
2500	914.2	14.8	79	319	23
2600	910.9	14.5	82	311	19
2700	907.7	14.3	85	310	25
2800	904.4	14.1	88	307	19
2900	901.1	14.0	90	309	17
3000	897.8	13.8	92	298	26

TABLE G.3

DATE: 6 / 7 / 83

TIME: 745 EST FLIGHT # 3 8:45 EDT

SURFACE HEIGHT= 279 FT MSL -999= MISSING DATA

HEIGHT FEET	PRESSURE MB	TEMPERATURE DEG C	RELATIVE HUMIDITY	WIND DIRECTION	WIND SPEED KTS
0	999.8	19.2	84	340	4
100	996.2	18.9	83	-999	-999
200	992.7	18.6	84	-999	-999
300	989.3	18.4	86	342	9
400	985.8	18.1	87	348	9
500	982.3	17.9	86	335	10
600	978.8	17.7	84	344	10
700	975.3	17.4	83	340	14
800	971.8	17.2	81	336	15
900	968.4	17.1	80	338	16
1000	964.9	16.9	78	338	16
1100	961.5	16.8	76	338	17
1200	958.1	16.6	75	337	18
1300	954.7	16.5	73	336	19
1400	951.3	16.3	71	337	18
1500	947.9	16.2	71	333	17
1600	944.5	16.1	71	328	20
1700	941.1	15.9	71	322	21
1800	937.8	15.8	72	318	22
1900	934.4	15.7	72	315	22
2000	931.0	15.6	72	315	22
2100	927.7	15.5	73	315	24
2200	924.4	15.4	74	317	22
2300	921.1	15.3	76	314	27
2400	917.8	15.2	77	313	21
2500	914.5	15.1	78	314	20
2600	911.2	15.0	80	300	20
2700	907.9	14.9	81	295	17
2800	904.7	14.8	83	281	14
2900	901.4	14.7	84	281	15
3000	898.2	14.4	84	297	23

TABLE G.4

DATE: 6 / 7 / 83

TIME: 823 EST FLIGHT # 4 9:23 EDT

SURFACE HEIGHT= 279 FT MSL -999= MISSING DATA

HEIGHT FEET	PRESSURE MB	TEMPERATURE DEG C	RELATIVE HUMIDITY	WIND DIRECTION	WIND SPEED KTS
0	999.9	19.9	82	330	6
100	996.4	19.4	80	308	10
200	992.9	19.0	78	-999	-999
300	989.4	18.9	78	-999	-999
400	985.9	18.7	78	357	8
500	982.4	18.4	81	350	8
600	978.9	18.1	83	332	9
700	975.5	17.7	84	332	10
800	972.0	17.4	85	333	10
900	968.5	17.2	85	328	11
1000	965.1	17.0	85	324	14
1100	961.6	16.9	84	329	15
1200	958.2	16.7	84	332	14
1300	954.8	16.5	83	330	14
1400	951.4	16.3	81	327	17
1500	948.0	16.2	80	323	21
1600	944.6	16.0	78	321	22
1700	941.3	15.8	78	320	22
1800	937.9	15.5	77	319	22
1900	934.6	15.3	77	316	23
2000	931.2	15.1	77	314	26
2100	927.9	14.9	77	313	25
2200	924.5	14.7	76	311	23
2300	921.2	14.5	76	310	24
2400	917.9	14.3	76	310	25
2500	914.6	14.1	76	309	26
2600	911.3	14.0	77	308	25
2700	908.0	13.8	77	306	22
2800	904.7	13.6	77	302	18
2900	901.5	13.5	78	299	17
3000	898.2	13.4	80	297	17

TABLE G.5

DATE: 6 / 7 / 83

TIME: 916 EST FLIGHT # 5 10:16 EDT

SURFACE HEIGHT= 279 FT MSL -999= MISSING DATA

HEIGHT FEET	PRESSURE MB	TEMPERATURE DEG C	RELATIVE HUMIDITY	WIND DIRECTION	WIND SPEED KTS
0	1000.0	20.4	70	330	7
100	996.5	19.8	66	-999	-999
200	993.0	19.5	67	330	7
300	989.5	19.2	67	307	14
400	986.0	18.9	68	308	15
500	982.5	18.6	69	315	17
600	979.0	18.3	69	316	18
700	975.5	18.1	70	312	22
800	972.0	17.8	71	322	12
900	968.6	17.5	72	325	13
1000	965.2	17.3	74	326	10
1100	961.8	17.0	76	323	14
1200	958.3	16.7	78	322	16
1300	954.9	16.5	79	325	23
1400	951.5	16.2	81	321	22
1500	948.1	16.0	81	325	14
1600	944.7	15.7	79	328	14
1700	941.3	15.5	79	321	13
1800	938.0	15.3	80	323	15
1900	934.6	15.0	80	319	13
2000	931.3	14.7	81	314	15
2100	927.9	14.3	82	313	18
2200	924.6	13.9	83	313	16
2300	921.2	13.6	84	315	10
2400	917.9	13.2	85	318	8
2500	914.6	13.0	87	318	17
2600	911.3	12.8	88	316	21
2700	908.0	12.5	89	312	18
2800	904.8	12.3	91	309	16
2900	901.5	12.1	92	310	18
3000	898.2	11.8	93	311	20

APPENDIX H

NWS - IAD Surface Meteorological Data

This appendix presents a summary of meteorological data gleaned from measurements conducted by the National Weather Service Station at Dulles. Readings were noted evey 15 minutes during the test. The data acquisition is described in Section 5.5.

Within each table the following data are provided:

Time(EDT)	time the measurement was taken, expressed in Eastern Daylight Time
Barometric pressure	expressed in inches of mercury
Temperature	expressed in degrees Fahrenheit and centigrade
Humidity	relative, expressed as a percent
Wind Speed	expressed in knots
Wind Direction	direction from which the wind is moving

TABLE H.1

SURFACE METEOROLOGICAL DATA (NWS)

TEST DATE: June 7, 1983 HELICOPTER: SA-355F TwinStar LOCATION: DULLES AIRPORT*

TIME (EDT)	BAROMETRIC PRESSURE (INCHES)	TEMPERATURE °F(°C)	HUMIDITY (%)	WIND	
				SPEED (MPH)	DIRECTION (DEGREES)
05:34	29.77	64(18)	100	5	310
05:45	29.77	64(18)	100	3	300
05:55	29.77	64(18)	100	4	320
06:19	29.79	64(18)	100	5	330
06:31	29.79	64(18)	100	4	340
06:46	29.79	64(18)	100	2	350
06:52	29.79	64(18)	100	3	340
07:15	29.80	64(18)	100	0	000
07:32	29.81	64(18)	100	3	310
07:47	29.81	65(18)	97	5	330
07:55	29.82	65(18)	97	5	330
08:19	29.82	66(19)	94	7	330
08:32	29.83	66(19)	94	10	340
08:45	29.82	66(19)	94	6	350
08:55	29.82	66(19)	94	5	330
09:16	29.82	68(20)	86	9	340
09:28	29.83	68(20)	84	8	340
09:46	29.83	68(20)	87	9	330
09:55	29.83	68(20)	87	11	330
10:17	29.83	69(20)	84	6	330

*Sensors located approximately 2 miles east of measurement array.

TABLE H.2

SURFACE METEOROLOGICAL DATA (NWS)

TEST DATE: June 7, 1983 HELICOPTER: SA-355F TwinStar (CONT) LOCATION: DULLES AIRPORT*

TIME (EDT)	BAROMETRIC PRESSURE (INCHES)	TEMPERATURE °F(°C)	HUMIDITY (%)	WIND SPEED (MPH)	WIND DIRECTION (DEGREES)
10:32	29.83	71(22)	79	10	310
10:47	29.83	70(21)	81	8	350
11:15	29.83	70(21)	79	9	320
11:32	29.84	71(22)	73	7	310
11:46	29.83	72(22)	73	9	330
11:54	29.83	73(23)	71	9	310

*Sensors located approximately 2 miles east of measurement array

APPENDIX I

On-Site Meteorological Data

This appendix presents a summary of meteorological data collected on-site by TSC personnel using a climatronics model EWS weather system. The anemometer and temperature sensor were located 5 feet above ground level at noise site 4. The data collection is further described in Section 5.5.

Within each table, the following data are provided:

Time(EDT)	expressed in Eastern Daylight Time
Temperature	expressed in degrees Fahrenheit and centigrade
Humidity	expressed as a percent
Windspeed	expressed in knots
Wind Direction	direction from which the wind is blowing
Remarks	observations concerning cloud cover and visibility

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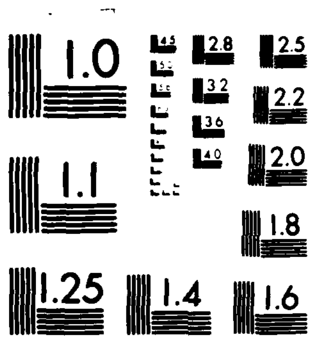
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

TABLE I.1

SURFACE METEOROLOGICAL DATA

TEST DATE: June 7, 1983 **HELICOPTER:** SA-355F TwinStar **LOCATION: DULLES, SITE #4***

TIME (EDT)	TEMPERATURE °F(°C)	HUMIDITY (%)	WINDSPEED AVG (MPH)	WINDSPEED RANGE (MPH)	WIND DIRECTION (DEGREES)	REMARKS
05:45	65(18)	96	4	3-5	320	100% clouds and haze, no sun
06:00	65(18)	99	3	1-5	320	very wet ground 10% puddles
06:15	65(18)	99	7	5-10	330	
06:30	65(18)	98	8	5-10	300	
06:45	65(18)	97	6	5-7	300	
07:00	64(18)	97	4	1-7	340	
07:15	65(18)	96	6	4-7	300	
07:30	65(18)	90	4	2-6	310	
07:45	65(18)	90	7	5-9	320	
08:00	66(19)	88	7	4-11	310	
08:15	66(19)	86	8	5-10	330	
08:30	66(19)	82	8	6-11	320	
08:45	67(19)	79	8	5-11	340	
09:00	67(19)	75	8	5-12	340	
09:15	68(20)	73	11	6-14	330	
09:30	68(20)	70	11	9-15	330	
09:45	68(20)	68	10	7-13	330	
10:00	68(20)	64	10	.5-13	330	90% light clouds
10:15	68(20)	60	10	8-13	330	light haze, some sun
10:30	69(20)	57	13	7-19	320	
10:45	69(20)	56	8	7-12	340	

SENSOR HEIGHT IS 9 FEET ABOVE GROUND

TABLE I.2

SURFACE METEOROLOGICAL DATA

TEST DATE: June 7, 1983 **HELICOPTER:** SA-355F TwinStar (CONT) **LOCATION: DULLES, SITE #4***

TIME (EDT)	TEMPERATURE °F(°C)	HUMIDITY (%)	WINDSPEED AVG (MPH)	WINDSPEED RANGE (MPH)	WIND DIRECTION (DEGREES)	REMARKS
11.00	70(21)	55	14	7-19	320	
11:15	70(21)	52	10	5-11	330	
11:30	70(21)	51	19	10-20	320	
11:45	71(22)	50	17	13-23	310	
12:00	7C(21)	50	17	12-21	320	

SENSOR HEIGHT IS 9 FEET ABOVE GROUND